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FACULTY OF ENGINEERING AND TECHNOLOGY

MASTER OF COMPUTING PROGRAM

MASTER THESIS

Building Learner Model for School Students Based on Multi-Entries from Students, Parents, and Instructors

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Declaration of Authorship

I, Ali A. Al-Jadaa, declare that this thesis titled, 'Building Learner Model for School Students Based on Multi-Entries from Students, Parents, and Instructors' and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a master degree at Birzeit University.

- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.

- Where I have consulted the published work of others, this is always clearly attributed.

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. . .

بسم الله الرحمن الرحيم

"قُلْ إِنَّ صَلَاتِي وَنُسُكِي وَمَحْيَايَ وَمَمَاتِي لِلَّهِ رَبِّ الْعَالَمِينَ

، لَا شَرِيكَ لَهُ وَبِذَلِكَ أُمِرْتُ وَأَنَا أَوَّلُ الْمُسْلِمِينَ".

(القرآن الكريم - سورة الأنعام)

صدق الله العظيم

Abstract

Building Learner Model for School Students Based on Multi-Entries

from Students, Parents, and Instructors

by Ali A. Al-Jadaa

Accuracy of student model is the heart of any Intelligent Tutoring System (ITS), whenever it becomes more accurate, the system becomes more intelligent. In the earlier versions of ITS, the student must submit a test before using the ITS. This test will be used to build the student model, which contains information about the knowledge of the student, his/her misconceptions, preferences and other related issues. However, this method doesn't work effectively for school students, because one test can't accurately evaluate their knowledge and misconceptions. In this research, we implement a system to get the student model for school students by allowing the students, parents, and instructors to add their assessment and feedback to the model. Then the system uses these multi-entries together with the traditional test to build an enhanced student model. Furthermore, in order to support collaborative learning, the student will get access to open this model for other instructors and peers. The proposed system has been applied on a group of students, their parents and instructors. The student's knowledge has been improved. also the parents where pleased to be engaged in the educational process.

ملخص

بناء نموذج المتعلم لطلبة المدارس بناء على مدخلات متعددة من الطالب وولي الامر والمعلم

دقة نموذج الطالب هي قلب التعلم الالكتروني الذكي، وكلما كان النموذج أكثر دقة كان النظام اكثر ذكاء . في الاصدارات السابقة للتعلم الالكتروني الذكي كان على الطالب التقدم لامتحان قبل استخدام النظام فقط. هذا الامتحان يستخدم لبناء نموذج الطالب ، الذي يحتوي معلومات عن مستوى معرفة الطالب والمفاهيم الخاطئة لديه او ميوله وامرو اخرى . الطرق التقليدية في بناء النموذج لا تكون فعالة لطلبة المدارس لان الامتحان وحده لا يكون دقيقا كفاية لتقييم مستوى معرفة الطالب والمفاهيم الخاطئة لديه. في هذا البحث سوف نبني نظاما يجعلنا نحصل على نموذج للطالب بان يسمح للطالب وولي الامر والمعلم بادخال تقييمهم وتغذيتهم الراجعة عن الطالب للنموذج . ثم النظام سيستخدم هذه المدخلات المتعددة مع الامتحان التقليدي لبناء نموذج محسن للطالب اضافة الى انه سيدعم التعلم التعاوني للطلبة، وسيعتمد النموذج على النموذج المفتوح الذي يتيح للطالب مشاهدة ونقاش النظام حول النموذج الخاص به. بالاضافة للمعلم وولي الامر ،وقد استطعنا رفع معرفة الطلاب كذلك اشركنا اولياء الامور في العملية التعليمية.

Acknowledgements

To my father with love and respect. . .

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Abbreviations

AI	Artificial Intelligence
CAI	Computer Assisted Instruction
DK	Domain Knowledge
ICT	Information Communication Technology
ITS	Intelligent Tutoring System
OLM	Open Learner Model
SK	Student Knowledge
SM	Student Model
SMILI	Student Model Invite Learner In
UI	User Interface
UK	Unrecognized Knowledge
UML	Unified Modeling Language

Chapter 1

Introduction

With the huge development in the Information Technology and the wide spread of the Internet, which becomes an essential source for receiving information, many developers tend to implement educational systems that participate in rising the educational level through Information and Communications Technology (ICT)[1][2]. These systems were able to spread all over the world, and they raised the educational level of students. Nevertheless, they could not replace the real teacher who takes into account the individual differences between students, and he/she provides the suitable information for students that fits in with their educational level. In later time, more accurate and intelligent systems appeared and tried to simulate the human teacher in his/her ability in defining misconceptions with students and providing solutions. These systems are regarded as Intelligent Tutoring Systems ITSs.This thesis concentrates mainly on the students' model and enhances the ability to diagnose the student more accurately in these systems.

This chapter shows an overview of the Intelligent Tutoring System (ITS) and the thesis motivation. Section 1.1 describes the motivation. Section 1.2 presents the research objectives and problem statement. The summary of progress and contribution of this thesis in section 1.3. At the end, it shows the organization of the thesis in section 1.4.

1.1 Introduction and Motivation

The student's knowledge level is essential part of the educational process, and it is a main part of the ITSs. The ITSs classically depend only on a short test to evaluate the students and it is the only entry for the student model[3][4]. However, the short tests or exams only do not usually reflect an ideal image of the student's level. In fact, the exam could be one of the factors that causes an aversion from the student towards learning. It may also be the main factor that makes the student feel frustrated and he might leave school. At the same time, we can not neglect the exam's evaluation because it can be easily applied to get a perspective about the students' level. That is why in this research, we are going to supply the ITSs with other entries features to evaluate the student to reach a better student model accuracy, in addition to make students more pleased and self-confident, and that encourages them to learn effectively.

This research will specifically be for school students, and the final system will be an integrative system with the school without cancelling its role. We will depend on four sources to enter the evaluation in the student model: Firstly, the student evaluates himself/herself based on the subject that he/she is going to learn. This is important because we really want to know from the student himself his/herself her educational needs to achieve them better. Secondly, the teacher evaluates the student. The closest person to the student educationally is his teacher in school. If we take benefit from this accumulative experience of the teacher about the students' level and their educational needs, that shall give the system a bigger ability to evaluate the students more accurately. Thirdly, the parents evaluate their children. It is known that most parents care about their children's level, and they are interested in raising their children's educational level. Therefore, they are often aware of their children's needs or at least part of them. As a result, the system will use this evaluation and benefit from it. In this way, parents actually participate in developing the educational process for their children. Finally, the system evaluates the student. This is a former procedure used in ITSs. It is basically a short test to the students' level. Then, after collecting the four opinions

concerning the students' level, the central system studies all these opinions, and it gives us detailed and accurate results about the educational needs for the students and their educational performance.

1.2 Research Objectives and Problem Statement

Our Proposed model is to build the students' model for students in the middle and higher grades (e.g. from 8th grade to 12th grade). The students at this level depend on their teachers and parents to help them get their knowledge. Moreover, the students at this level can assess themselves, determine their interests, and have good knowledge about computer/mobile software.

The main objectives of this research are:

1. Implementing an enhanced student model by allowing the students, parents, and instructors to add feedbacks to the system.

2. Investigating how we can support the students to negotiate with the system regarding the contents of their models?

3. Investigating how we can support students with ITS which use open learner model? .

4. Evaluating the effects of building such a model on students' performance, especially on collaborative learning between peers.

1.3 Summary of Progress and Contribution

Our contribution is to involve the assessment of students, teachers, and parents in building the student model. By this, the system will have more resources about the students' knowledge level, which shall make the final assessment of the students more accurate. However, the data entered by these different actors may have

some contradictions regarding the students' knowledge. In this case, the system will use some defined rules to build an optimized learner model. The student can still negotiate this model if he/she thinks that it does not reflect his/her real knowledge as shown in figure 1.1.
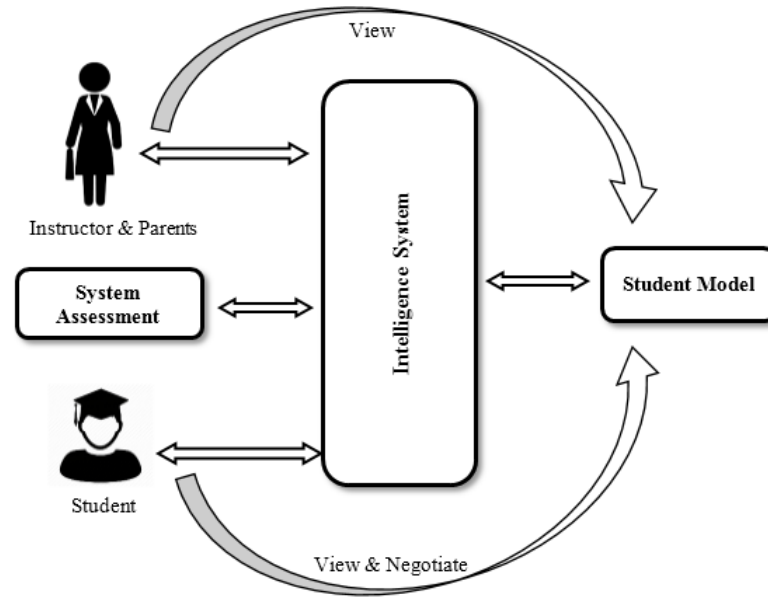
FIGURE 1.1: Proposed Open and Negotiable Learner Model Based on Multi-Entries

Choosing the weight for each type of assessment for students takes a long time and considerable effort. In our research, we was determine the weights through interviews with educators who have much experience in this area.

The weights for each assessment type were put as the following:

1. The biggest assessment weight is given to the system assessment (35%). The system evaluates the student in five different concepts with multiple questions for each concept. The registered values for the students are from 50.

2. The second assessment weight is for the instructor (30%) because he is the closest person to the student in the real education world based on interviews of educators. Therefore, the instructor is the best who can give us a clear

picture about the students' knowledge level. The system allows the instructor to assess the student in five concepts, and the concept values are from 50.

3. Student self-assessment, which is based on the questionnaire that we prepared to find whether the students can assess themselves and can determine their educational needs. So the weight of the student self-assessment is(20%). The system allows the student to assess himself/herself in five concepts; the value for each concept is from 50.

4. Parent assessment, which has the lowest weight. Based on interviews of educators, the parents are not actually in contact with their children, but there are a few number of parents who want to contribute in their children's education. As a result, we hold a meeting to describe the importance of their contribution for their children. The parent assessment is (15%). The system allows the parents to assess their children in five concepts, for each concept, the value is 50.

In addition, we will work to support learning reflection by making the model open for the students themselves, teachers and parents. In other words, the students shall get into the habit of linking and constructing meaning from their experiences or by viewing their model[5]. the student learning and We will also support collaborative learning by giving the students the access to open the models for other peers. This will help the educational process in several aspects, [6] "Successful collaboration means asking questions to gain a better understanding of the main concepts, elaborating and justifying opinions and sharing and explaining ideas", and they will be achieved with open model, especially between peers[7]. Another contribution for this work is to make the student model negotiable and that means the student can negotiate (limited with some rules) with the system, about his/her model.

1.4   Feasibility Study

Some questionnaires were prepared for students, teachers and parents (see appendix A). These questionnaires had four objectives. Firstly, to know the confidence of the students, teachers and parents on the exam to determine the knowledge level and the educational needs for students. Secondly, to know the students' confidence about themselves and their ability to determine their educational needs. In this way, the teacher will use this self-evaluation to choose the best pedagogical strategies. Thirdly, to know the ability of teachers to determine the level of their students and understand their educational needs in order to improve the educational process in general. Finally, to know the ability of parents to follow up their children and determine their needs, and to share this knowledge with the teachers so that they can develop the educational process as well.

The results of the primary analysis for the questionnaire were as the following:

1. There was a lot of confidence that the exam is irreplaceable because it's good and can easily be applied; the rate was 69%. The standard deviation of the data was less than 0.9, and that is an indicator of agreement.

2. There was a lot of self-confidence between students that they are capable of identifying their needs and pass them to their teachers; the rate was more than 90%. The standard deviation of the data was less than 0.7, and that is an indicator of a big agreement.

3. The students were confident with their teachers to determine their weaknesses and fix them, and to choose the suitable educational strategies for each one; the rate was 70%. The standard deviation of the data was less than 0.9, and that is an indicator of agreement.

4. The students were confident with their parents that they had the ability to determine their educational needs and transfer this assessment to the teachers; the rate was 63%. The standard deviation of the data was less than 1.0, and that is an indicator of agreement.

In conclusion, students really prefer to have other entries which locate their educational needs in order to raise their knowledge level. Moreover, these entries give them better options and better pedagogical strategies.

Note : All the data analysis of the questionnaires was attached in addition to the percentages, the standard deviation and the statistical diagrams which reflect all these analysis in appendix B.

1.5   Organization of the Thesis

In addition to this brief introduction, this thesis report includes Chapter 2: Background and Literature Review, which includes an overview about E-learning Environments, Intelligent Tutoring System, Intelligent Tutoring System Architecture, Student Model and Open Learner Model. Chapter 3: System Requirements, which includes the functional requirements, nonfunctional requirements for the proposed system. Chapter 4: System Implementation and Testing. Chapter 5 about system evaluation. Finally, chapter 6 presents a conclusion and the future work.

Chapter 2

Background and Literature Review

This chapter shows a background about ITS and some old approaches, then presents the four modules of the ITS in detail.

2.1 E-learning Environments

Systems which depend on a technological environment in education are called computer-assisted instruction (CAI)[8]. It also means information and communication technology in education (ICT)[9]. All these terms refer to one concept which is using technology in education. However, the problem of these systems is in the way they function. They present the courses information serially from A to Z without taking into consideration the knowledge level of the student. As a result, these systems don't distinguish between students, and they use the same technique which is presenting all information only with all students .

Although this system is good to some extent, in fact it doesn't satisfy the educational needs for specific levels of students. For instance, if a student is weak or has some misconceptions, the system won't be able to spot these weaknesses, and so they won't be fixed. Similarly, if the student is excellent, the system won't be

able to distinguish him, and hence give him more difficult material or speed his learning process. It's known that the superior student just needs a few hours to understand the course without the need to take the whole course.

This leads us to the necessity of having an educational system which simulates the teacher who measures the level of his students and decides what is suitable for each one of them individually. This system appeared recently, and it was called ICAI[10, 11], then it finally improved to become ITS [3, 12].

2.2   Intelligent Tutoring System Overview

The scientists split into two schools by the early 1980s. The first school and the smaller one was called "Exploration Environments" [13], the famous example in this school is LOGO language by Papert [14], which introduced the student to learn by programming directly, and he thought the classic school did not have a place in our future life; therefore, some researchers called this school "Revolutionaries". However, this school, didn't achieve success and widespread, because it actually wanted to change radically, and that was impossible without the inserts. The second and the larger school was called "Intelligent Tutoring", who presented themselves as "Reformists", and they preferred a gradual improvement, by using AI techniques. Our research will focus on this school.

The term Intelligent Tutoring System (ITS) expresses the development of computer programs for teaching students effectively, in order to provide tutors to know what they teach, who they teach and how to teach it[13]. Wenger defined ITS as ""Computer-based instructional systems with models of instructional content that specify what to teach, and teaching strategies that specify how to teach" [3] The motivation to build the (ITS) is to simulate the human teacher and effectiveness of one-to-one learning[3]. In real classroom, there is one teacher for many students, so it's difficult to apply the one-to-one approach. Most teachers are trying to take into account the individual differences between students, as-much-as possible, although, some students may be neglected.

Since the advent of computer science, there were many attempts to completely replacing the human teacher with applications. Theoretically, these attempts won't be science fiction, given in Artificial Intelligence (AI) field. Ideally, advancing in natural language processing allow the system to talk with student as human teacher. Developing a powerful ITS must have a combination of computer science (AI), cognitive psychology and educational research as shown in figure 2.1), so many researches in this filed are producing by involving scientists in computer and education.

Practically, this ambition is facing many challenges. Firstly, natural language processing is not yet good enough to emulate a real conversation between a student and a teacher. Secondly, (ITS) can't completely replace a human teacher because there is some students who are not suitable with application-based instruction, in addition, some topics are not appropriate for application-based instruction.
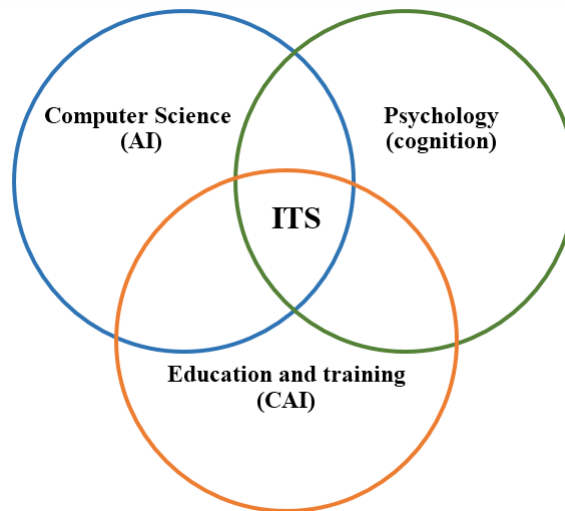
FIGURE 2.1: Intelligent Tutoring System.

2.3 Intelligent Tutoring System Architecture

In the literature, there is no clear general structure of ITS [15], but there are many researches, which are considered as a consensus, say that there are at least three modules, the Expert Knowledge Module, the Student Model Module and

the Tutoring Module [16]. The next researches as Winger's [3], add User Interface Module to the previous three modules. As a result there are four basic modules in ITS, as shown in figure 2.2.
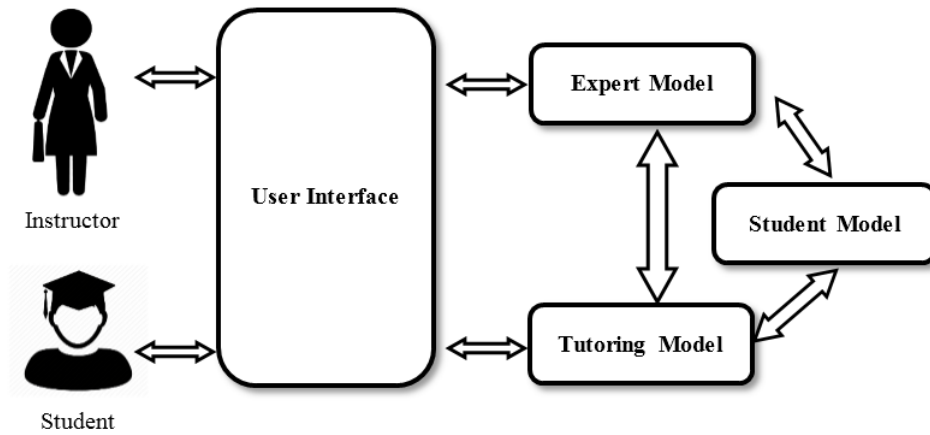
FIGURE 2.2: ITS Architecture.

2.3.1 Expert Knowledge Module

This model means what we need to deliver to the student. That is why many researches called it the heart of ITS [17]. This module acts as a data repository which contains information about the courses, courses content, and the relations between course elements (hierarchy). It is similar to the book index (chapters, sections, subsections . . .). Principally, there are two types of content or functions in this module, the first one is called Domain Model which is the source of knowledge. In addition, it contains the questions and the problems of the students. The second one is called Expert Model, and this model must generate the solutions, and these solutions will be compared with the student solutions [3].

2.3.2 Tutoring Module

This module is the brain of ITS because it will decide the suitable type of content base on the Domain Model for the suitable student depending on the information

about the student that we get from the Student Model. Moreover, it must decide the correct strategy of teaching for each student individually. In addition, this module can decide the next problem selection or next course selection for the student [18]. This module represents a human expert teacher, who can generate knowledge, answer the questions, evaluate student answers and choose the correct strategy for each one.

2.3.3 Student Model Module

It contains information about student's knowledge, his level, misconceptions and other issues. The student model represents a dynamic model [3], so it contains some functions and roles, which we will describe in section 2.4 in details.

2.3.4 User Interface (UI) Module

The importance of this module comes from [3]. The UI module is the final form in which the system presents a course. In other words, the UI module can make the presentation of the course more or less understandable. This is similar to a teacher in real classrooms, who must convince his students about himself by making a better communication with them, and this process can be crucial to the students' acceptance of their teacher as well as the system in ITS.

2.4 Student Model

Education is a process of communication between the teacher and the student, and in order to communicate effectively, the teacher must have a clear vision of the student's knowledge level and the appropriate pedagogical methods for each student individually. That is exactly what the student model presents in ITS, therefore, Holt defined the student model as "representation of the computer

system's beliefs about the learner", and "abstract representation of the learner. . ." [19].

The ITS student model represents competencies and learning achievements [18] for each student, this model may involve three areas [14]:

1. Content skills (e.g., biology, mathematics, history, geography. . .)

2. Particular strategies for learning (e.g. learning style)

3. Effective characteristics (e.g. emotional state).

Most ITSs identify the level of the student knowledge (content skills), using a short quiz [13], but the particular strategies (learning style) and emotional state are not easy to determine, and they need to be inferred from the student behaviors and observations in long term. In other words, student model represents what the system believes about the student (e.g., misconceptions, plans, goals, knowledge level...), in addition to the student stereotypes, records, and other interactions with the system.

Student model will provide the student's information to other ITS modules, especially the teaching module, to determine the suitable strategy for each student. On the other hand, the student model may use the domain expert module to identify the misconceptions in the domain of knowledge. Representing the information in student model takes many forms, from simple numeric presentation to complex graphical network [20].

2.4.1 Student model Functions

According to [21], there are three functions in student model. The first one is Evaluation Function, which will evaluate the solutions of the student using the domain model. The second one is Update Function, which will update the information in the student model when it appears. The last one is Diagnosis Function, and this function is used to find misunderstood concepts.

2.4.2 Student Model Types

There are four types of student model according to knowledge types:

2.4.2.1 Overly Model

This type presents the knowledge of the student as a subset of domain knowledge [21]. In other words, this model represents what the correct information that the student knows from the domain knowledge as shown in figure 2.3. (e.g. SCHOLAR, developed by Carbonell 1970)
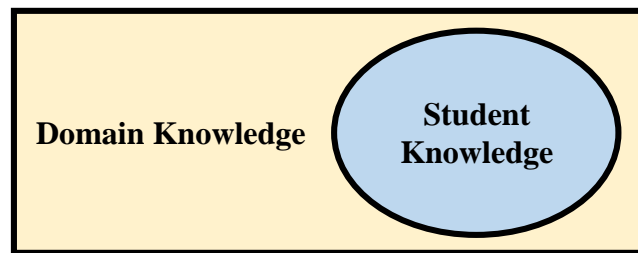
FIGURE 2.3: Overly Model.

2.4.2.2 Extended Overlay Model

In this type the student model represents the correct and incorrect (bugs) knowledge, and the system can predict the incorrect information which a student may have [21] as shown in figure 2.4. (e.g. BUGGY, developed by Nagel and Swingen, 1998)

2.4.2.3 Simple Perturbation

In this type, the system considers everything out of the domain knowledge as misconceptions. The problem of this type is that the student's information may be correct but it does not exist in the domain knowledge [21], and the system will consider it as misconceptions as shown in figure 2.5.
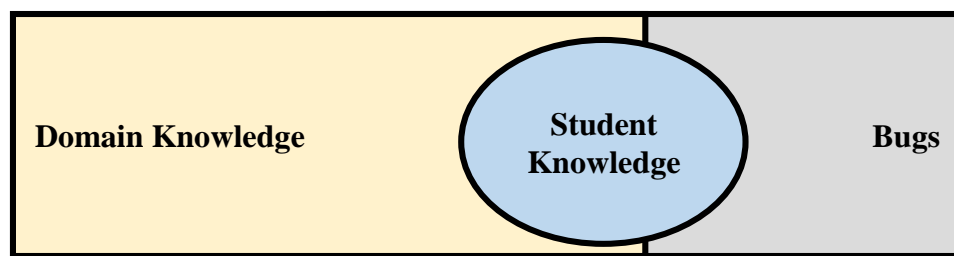
FIGURE 2.4: Overly Model.[21]
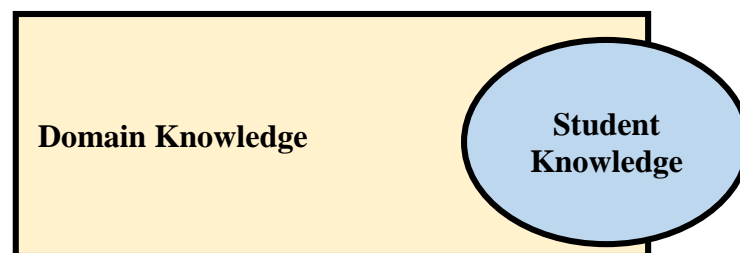
FIGURE 2.5: Simple Perturbation.[21]

2.4.2.4 Advanced Perturbation

This type is a flexible one because the system assumes that the student may have correct information which does not exist in domain knowledge. So that the system must decide if this information is correct or not[21], as shown in figure2.6
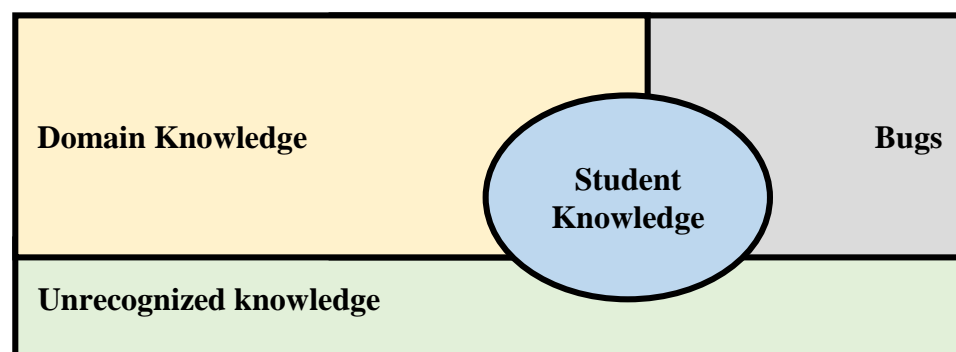
FIGURE 2.6: Advanced Perturbation.[21]

2.5 Open Learner Model

Most of traditional ITSs depend on close student model, and that means, the student model can be viewed or changed only by the system. Next research as [22] presents the Open Learner Model. The term Open Student Model refers to the term Open Learner Model. Susan Bull defined it as "Learner models that can be viewed or accessed in some way by the learner, or by other users (e.g. teachers, peers, parents)" [23].

2.5.1 Use of Open Learner Model

In the literature , the open learner model is applied in different student modeling techniques such as Conceptual Graphs [24], Bayesian models [25], Fuzzy models [26], Constraint-based models [27, 28], and Simple Weighted Numerical models [29].

2.5.2 Present information in Open learner Model

There are many ways used to represent the open learner model in the literature, for example, Skill meters [27], structured view in OLMlets [30], Arrows in a target [31], level of performances[32], smiley faces[33], trees [34], and the flexi-OLM concept map [35].

2.5.3 Open Learner Model Benefits

Susan Bull in SMILI [36]identifies nine points which may be useful, and we can classify them as:

To Student Himself/Herself

It is very important to the student to view his/her model to know his/her knowledge level to decide the suitable plans to achieve his/her goals. In addition, the student feels that his/her model as a lecture to improve his/her level and exceed

his misconceptions[22]. On the other hand, the student model will be more accurate when the student modifies the information about himself/herself if the system allows update or negotiates the model with the student.

To Peers

There are many benefits when the student views the other students' models or other students view his/her model. About the student, he/she will compare his/her level with other students, and that encourages the competition and enhances collaboration between them [22].

To Teachers

The open learner model helps the teachers to decide the level of his/her students and that makes it easy to compare between them. As a result, the teacher can improve the collaboration between his/her students [22] On the other hand, Susan Bull in [23] said, "the open learner model help the teacher providing formative assessment opportunities for students, but also enabling the learner model to be used as a summative assessment".

To Parents

The open learner model facilitates interaction and communication between parents and their children or parents with their children's teacher, and that keeps the parents – up to date about the progress of their children.

To The System

Susan Bull in [23] determines two benefits of open learner model to the system. The first one is "Increasing the accuracy of the learner model data if the user is allowed to contribute additional or corrective information to enable a more precise adaptive interaction to follow". The second one is "Increasing learner trust in an adaptive educational environment by showing the system's inferences about their knowledge".

Chapter 3

System Requirements and Specifications

In this chapter, we will introduce the proposed system functional and nonfunctional requirements. Furthermore, we will explain the language we will use in the project and other tools.

Four groups of users will use our system:

1. Instructors: This group contains the users who represent the teachers in real world.

2. Students: This group contains the students who take the lectures.

3. Parents: This group contains the parents of each student who register in the system.

3.1 Users (Group Specification)

There are three groups of registered users, who interact with the system. Figure 3.1 shows these users' hierarchy, and tables 3.1,3.2, 3.3
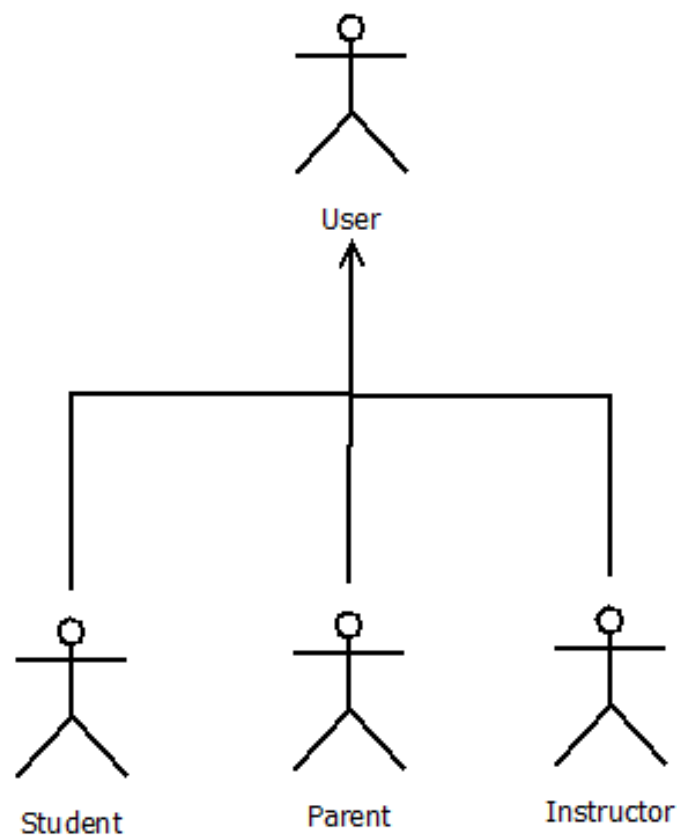
FIGURE 3.1: UML- Users Hierarchy

Group Name	Student
Description	The person who learns course.
Profile Data	Full name, email, address, phone number picture, the educational level
Super-group	User
Subgroup	None
Relevant use case	Add assessment for himself/herself, edit profile, view his model and view for other peers.
Object – read mode	His/Her information, his/her model information
Objects – content management mode	His/Her information, his/her self- assessment, help his/her peers.

TABLE 3.1: Student's Description

Group Name	Parent
Description	The person who is responsible for the student at home.
Profile Data	Full name, email, address , phone number, picture, the educational level
Super-group	User
Subgroup	None
Relevant use case	Add assessment for his/her child, edit profile, view students' model
Object – read mode	His/her information, his/her students' model information
Objects – content management mode	His/her information and assessments.

TABLE 3.2: Parent Description

Group Name	Instructor
Description	The person who adds the educational material.
Profile Data	Full name, email, address,phone number, picture, the educational level
Super-group	User
Subgroup	None
Relevant use case	Add assessment for students, edit profile, view students' model, manage content of knowledge
Object – read mode	His information, student model information
Objects – content management mode	His/her information, his/her assessment.

TABLE 3.3: Instructor Description

3.2 The Functional Requirements

In this section, we will describe the functional requirements for each group of users. To do that, we will use the UML use-case diagram by using Dia Tool v 0.9.

3.2.1 The Instructors' Environment

The Instructors' requirements can be captured graphically by using the use-case diagram, and textually by using the scenario description, which will be illustrated in the following sub-sections. Figure 3.2 shows the UML use-case diagram for instructors' environments, and the instructors' scenario description as shown in table 3.4.
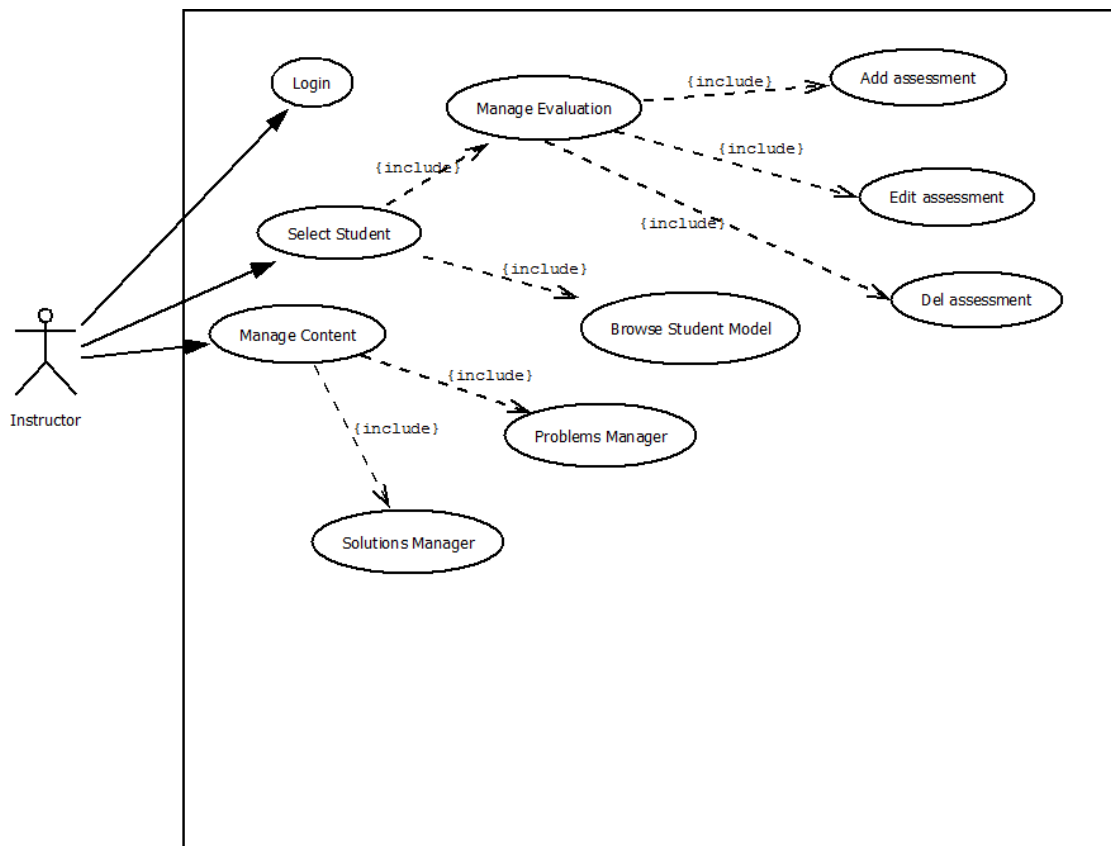
FIGURE 3.2: UML- Use Case :The Instructor Group

Instructor Scenario Description	
Actors	**Instructor**
Description	The instructor can generate the domain of the course, such as the content of the course, problems and solutions. On the other hand, the instructor in our approach can add assessments for his/her students.
Precondition	The instructor must be added to the course by the supervisor.
Sequence Flow of Events	The instructor selects a course and manages the content, problems and solutions.
Data	Text and numerical information about course domains and the assessments for students.

TABLE 3.4: Instructor Scenario Description

3.2.2 The Parents' Environment

The Parents requirements can be captured graphically by using the use-case diagram, and textually by using the scenario description, which will be illustrated in the following sub-sections. Figure 3.3 shows the UML use-case diagram for parents' environments, and the parents' scenario description as shown in table 3.5.

FIGURE 3.3: UML- Use Case :The Parents Group

Parent Scenario Description	
Actors	**Parent**
Description	In our approach, the parents have a group, which is added by the supervisor to enable them to assess their children.
Precondition	The parents must be added by the supervisor.
Sequence Flow of Events	The parents select the model of their children and browse it. The parents are enabled to add, edit and delete assessments for their children.
Data	Text and numerical information about the course domains and the assessments for students.

TABLE 3.5: Parent Scenario Description

3.2.3 The Students' Environment

The Students' requirements can be captured graphically by using the use-case diagram, and textually by using the scenario description, which will be illustrated in the following sub-sections. Figure 3.4 shows the UML use-case diagram for students' environments, and the students' scenario description in table 3.6.


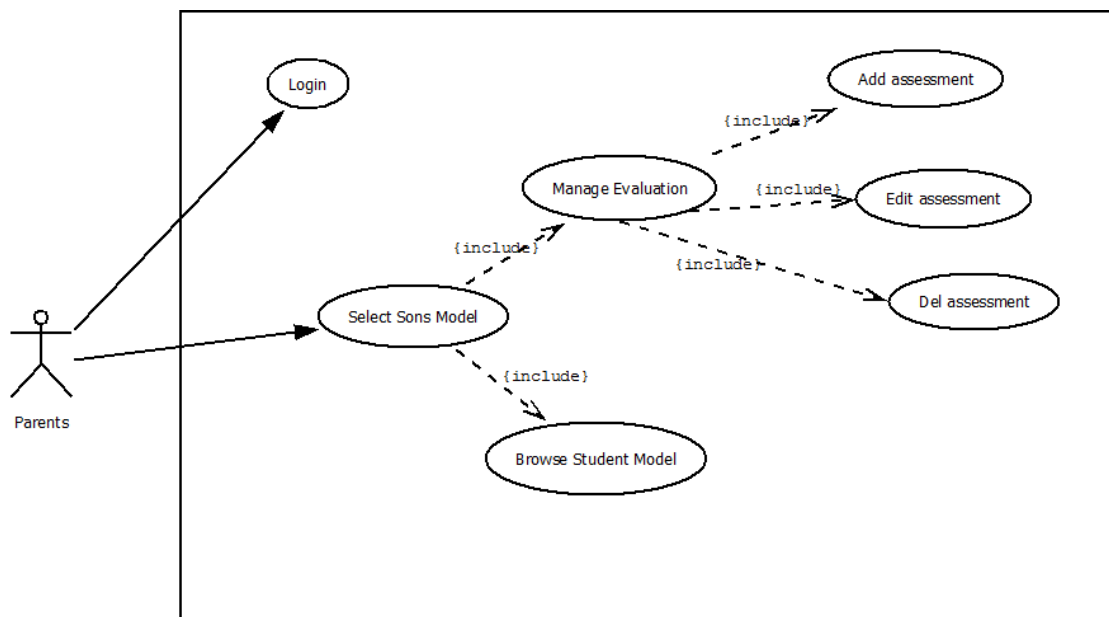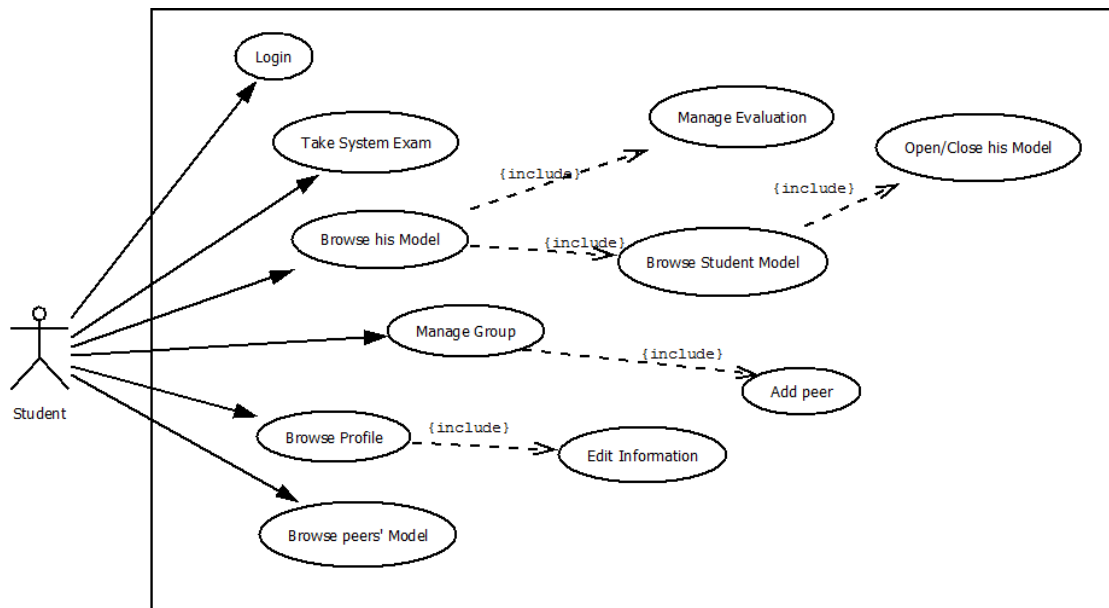FIGURE 3.4: UML- Use Case :The Students Group

Student Scenario Description	
Actors	**Student**
Description	A student must get a test in the course,and he/she can see his/her model and open it for the chosen peers.In our approach, the student can add assessments about himself/herself .
Precondition	The student must be registered in the course by the supervisor
Sequence Flow of Events	1. The student gets a test. 2. The student browses his/her model. 3. The student can manage his/her model: Edit his/her basic information. Set the state of his/her model (Open, Close). Choose the peers who are allowed to see his/her model. He/She can enter the assessments about himself/herself 4. The student can browse his group
Data	Text and numerical about students' information or self-assessment

TABLE 3.6: Student Scenario Description

3.3 Nonfunctional Requirements

In addition to the functional requirements, which are necessary and essential for the users of the systems, there are some requirements related to the environment itself. The most important nonfunctional requirements are

- Security:

   1. Security issues related to the users' accounts: this requirement mainly focuses on the process of signing out from the system by the user, and then other users should not be able to open that user's account.

   2. Security against database hackers: All the information about the system's users is stored in a database server. This database must be protected against any hacker who tries to hack the system.

- Availability:

   1. The system shall be available to users all the time, with exception of being down for maintenance no more than one hour per week.

   2. If the system crashes, there should be a backup version each hour .

- Portability:

1. The system should be able to browse on environments (Desktop, Mobile, and Tablet).

2. The system should be able to support browsers (Chrome, Firefox, Opera and Internet Explorer).

3.4 Course Selection

We chose the course of information technology for the 10th grade. The students find it difficult to study this material because it shifts them from using technology to developing it. We also want to present it in a simple way by dividing the material into three levels: high, middle and low, to suit all students' levels. In addition, we offer some pedagogical strategies such as Brainstorming, Role-playing, Dialogue and Debate and others, which will suit all the trends and tendencies among students.

3.5 Programming Languages Selection

We chose the ASP.net programming language, which is simple and easy to use, especially by Visual Studio environment, which provides many tools and frameworks to help developers. This language is accredited by the Ministry of Education in Palestine, which we would like to have partnerships with them. Furthermore, this language is compatible with SQL Server popular database, in addition to the qualities of strength, resilience and the high level of security.

Chapter 4

System Implementation and Testing

This chapter discusses the implementation of the system. Section 4.1 presents the design and implementing of the system database. Section 4.2 shows the implementation of the web application, which includes the student's environment, parents' environment, instructor's environment and the environment of the system's administrator. Section 4.3 talks about the testing of this web application.

4.1 Design and Implementation of the System Database

We must determine what we need to store in our database. This can be achieved by looking at the system's requirements:

1. The users of the system: There are many types of users in our system, and each type has basic information as the user ID, name, address, email etc., because of this, we must have a table for users with different privileges.

2. The knowledge content: It is important for our system to store the content of knowledge as concepts, misconceptions, questions, answers and so on. Therefore, we must have a table or set of tables to store these contents.

3. Student Model: The student model is the container of the student's level about concepts. Therefore, it is important to build a table to store the information about the student's knowledge, which comes from different entries (system assessment, self-assessment, parent assessment, instructor assessment).

4.2 Implementation of the Student's Model

4.2.1 Students' Environment

The student has many requirements in the system. Figure 4.1 shows the structure of these requirements. In the next subsections we presents the main pages in students' environments.
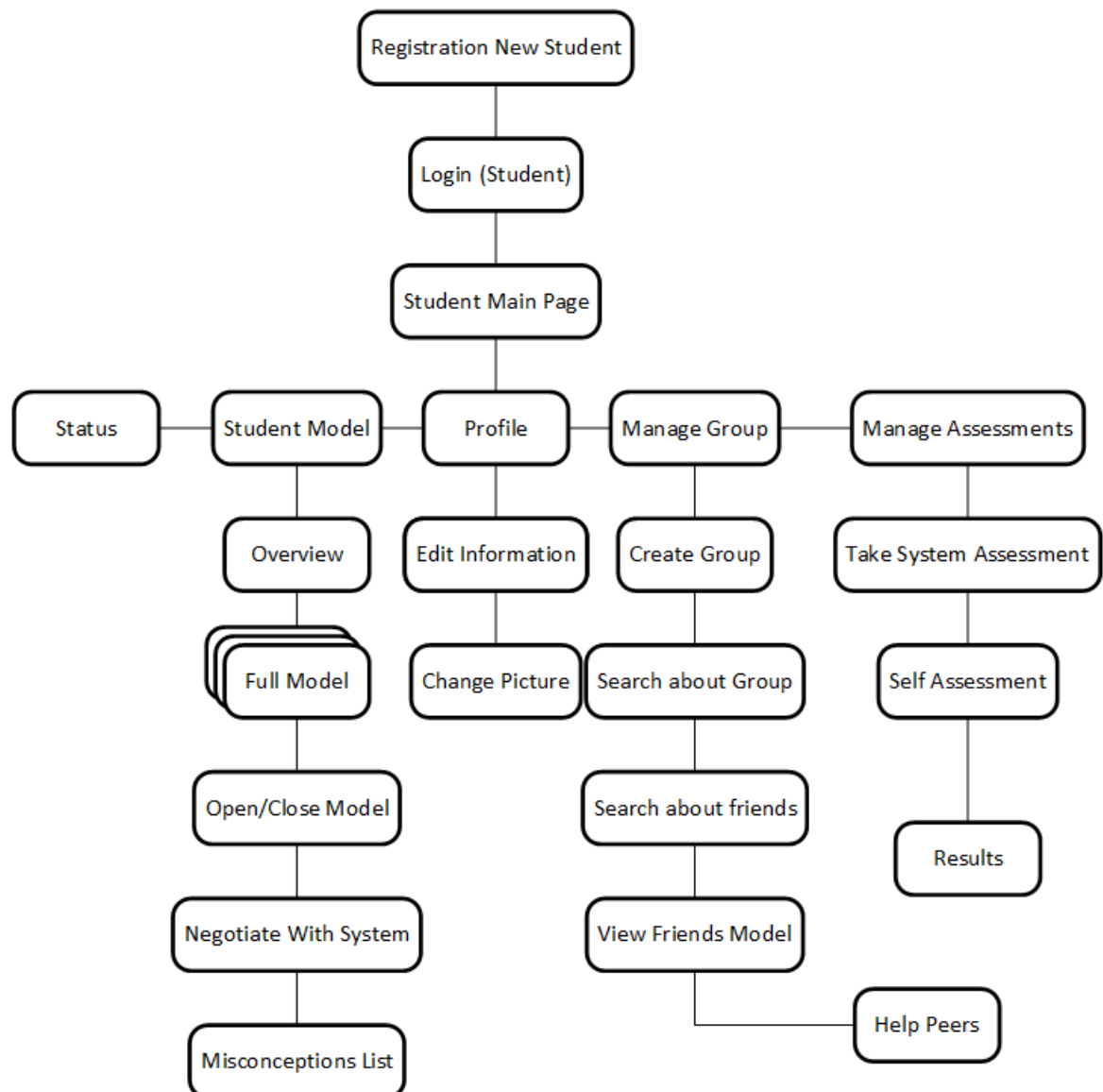
FIGURE 4.1: Student Environment.

4.2.1.1 Student Profile

The student profile is a page which presents the basic information about the student such as the name, email, parents, level of education etc. The system also allows the student to edit his/her information, as shown in figure 4.2.

FIGURE 4.2: Student Profile.

4.2.1.2 Student Take System Assessment

The system asks the student to take a test in some selected concepts as shown in figure 4.3. After the student takes it, the system registers that in his/her table. The results will also be registered in the student knowledge table in the database. If the student has the same misconceptions three times, the system will put these misconceptions on record.
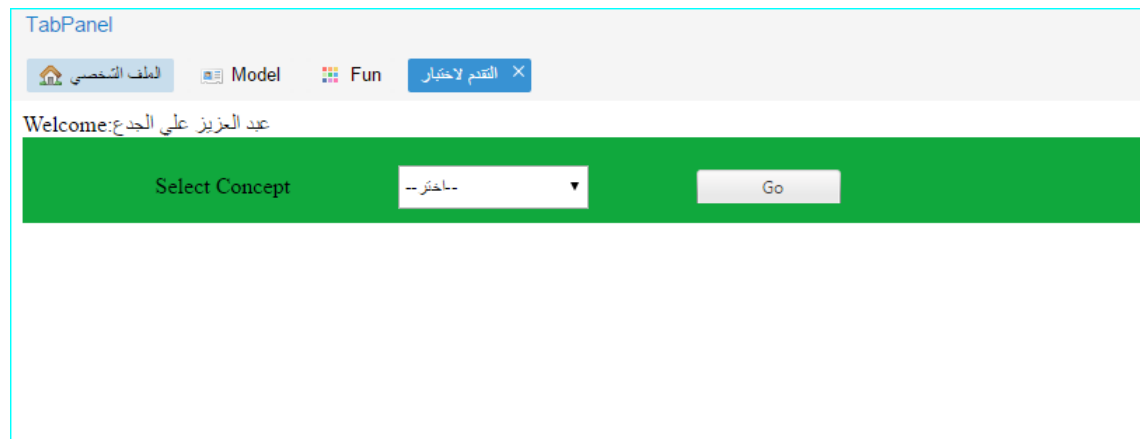
FIGURE 4.3: System Assessment.

4.2.1.3 Self Assessment

This system allows the student to determine his/her educational needs through assessing himself/herself in different concepts. This assessment results will be registered in the student's assessment table in the database. These results will be presented in the student model later on. The system allows the student to enter the values by using slider or text field as shown in figure 4.4.

FIGURE 4.4: Slider Assessment.

4.2.1.4 Students' Model

Each student has a model, which presents the results of the four different assessments and these results determine the knowledge level of the student. This system mainly focuses on the open learner model in which the system allows the student to see his model and negotiate about his/her level, see figure 4.5. The student model presents the results in different ways; in graphical bar chart as shown in

figure 4.6, graphical circle pointer as shown in figure 4.7 and data table as shown in figure 4.8. In the other hand, the student can view a list of his/her misconceptions if it is founded as shown in figure 4.9 , and the student can view the peers' models who are in his group. Moreover, the student can help his/her peers in specific concepts. The system calculates the final result about the student's level of knowledge, which comes from the four entries .

FIGURE 4.5: Negotiate the System.
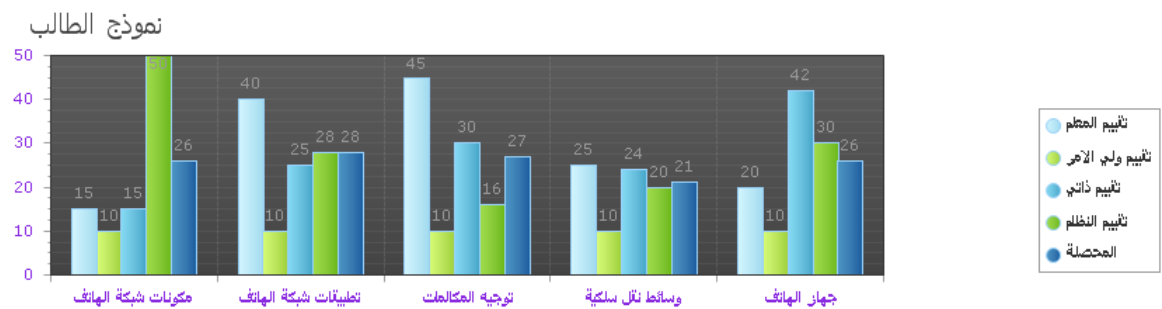
FIGURE 4.6: Chart Bar Result.
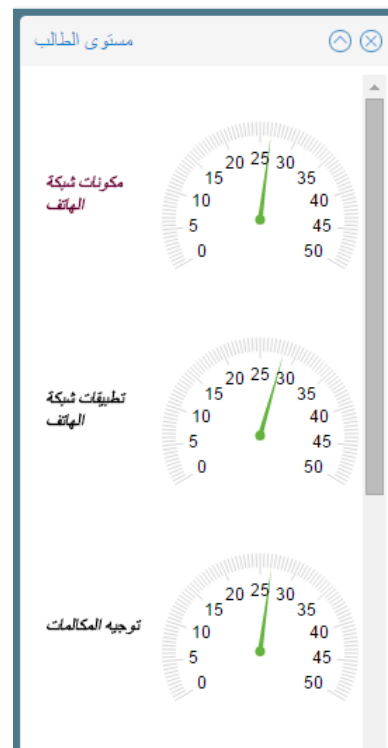
FIGURE 4.7: Circle Pointer.

FIGURE 4.8: Table of Data.

FIGURE 4.9: Misconceptions list.

4.2.1.5 Students' Status

This page contains a table about the status for the four different assessments. This table aims to present which assessment type is taken or not as shown in figure 4.10.

FIGURE 4.10: Student Assessments Status.

4.2.1.6 Students' Groups

The system allows the student to create a group and other students can add themselves to it. Each group has an admin who is the group creator by default. The student can also search for other groups. The main aim is to create students' groups to determine the students' peers, who can view their models or help each other. See figure 4.11.

FIGURE 4.11: Create Group.

4.2.2 Instructors' Environment

The instructor has many requirements in the system, see figure 4.12, which shows the structure of these environments.
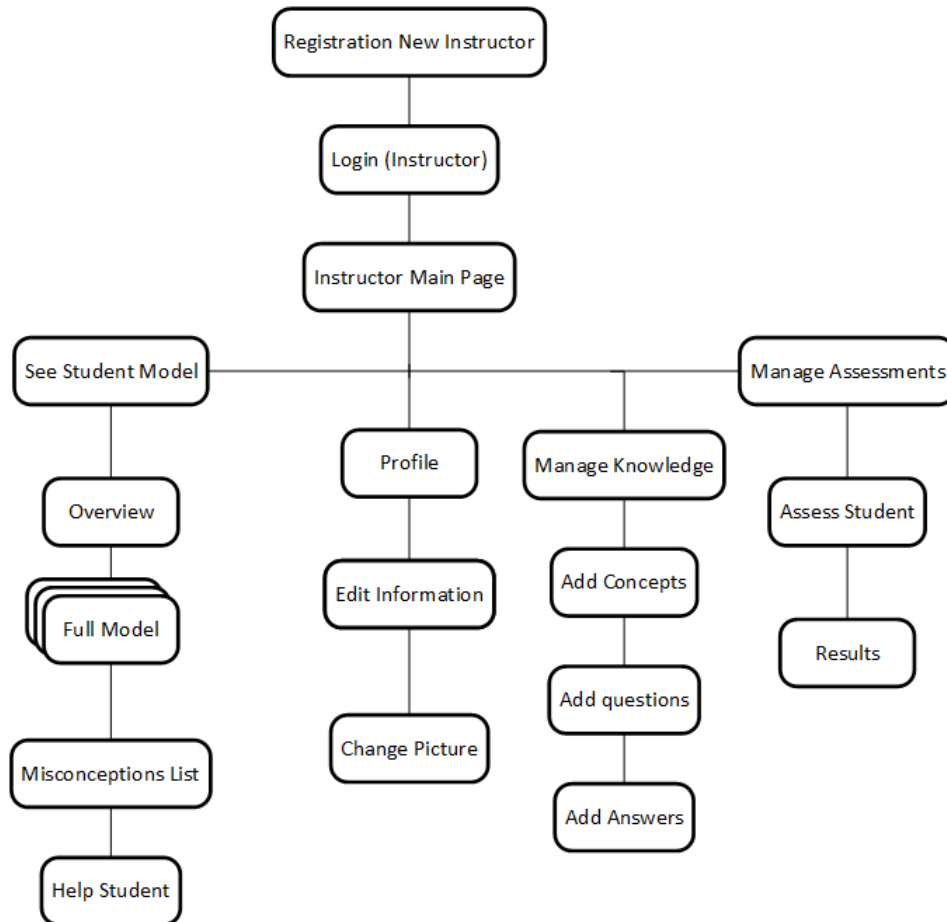
FIGURE 4.12: Instructor Environment.

The main pages in this environment are:

1. **Instructor Profile**, this page presents the basic information about the instructor such as the name, the email and so on. The system allows the instructor to edit his/her information.

2. **Instructor Assess Students Page**, the system adopts multi entries for students' model. One of these entries is the instructor's assessments, and these assessment's values are entered by slider or text field. The system

allows the instructor to assess all his/her students. This assessment's values will be presented in the students' model later on.

3. **Instructor View Students Models**, as mentioned earlier, the system adopts an open learner model in which that system allows the instructor to view his/her students' models.

4. **Instructor Manage Contents**, the system allows the instructor to manage the content of his/her course, which includes concepts, questions and answers. The system allows the instructor to add, edit or delete these contents. In addition, the system allows the instructor to import or export the different contents from or to excel sheets, which simplify the process of adding contents as shown in figure 4.13.

FIGURE 4.13: Content Manager.

4.2.3 Parents' Environment

The parents have many requirements in the system; see figure 4.14 that shows the structure of this environment.
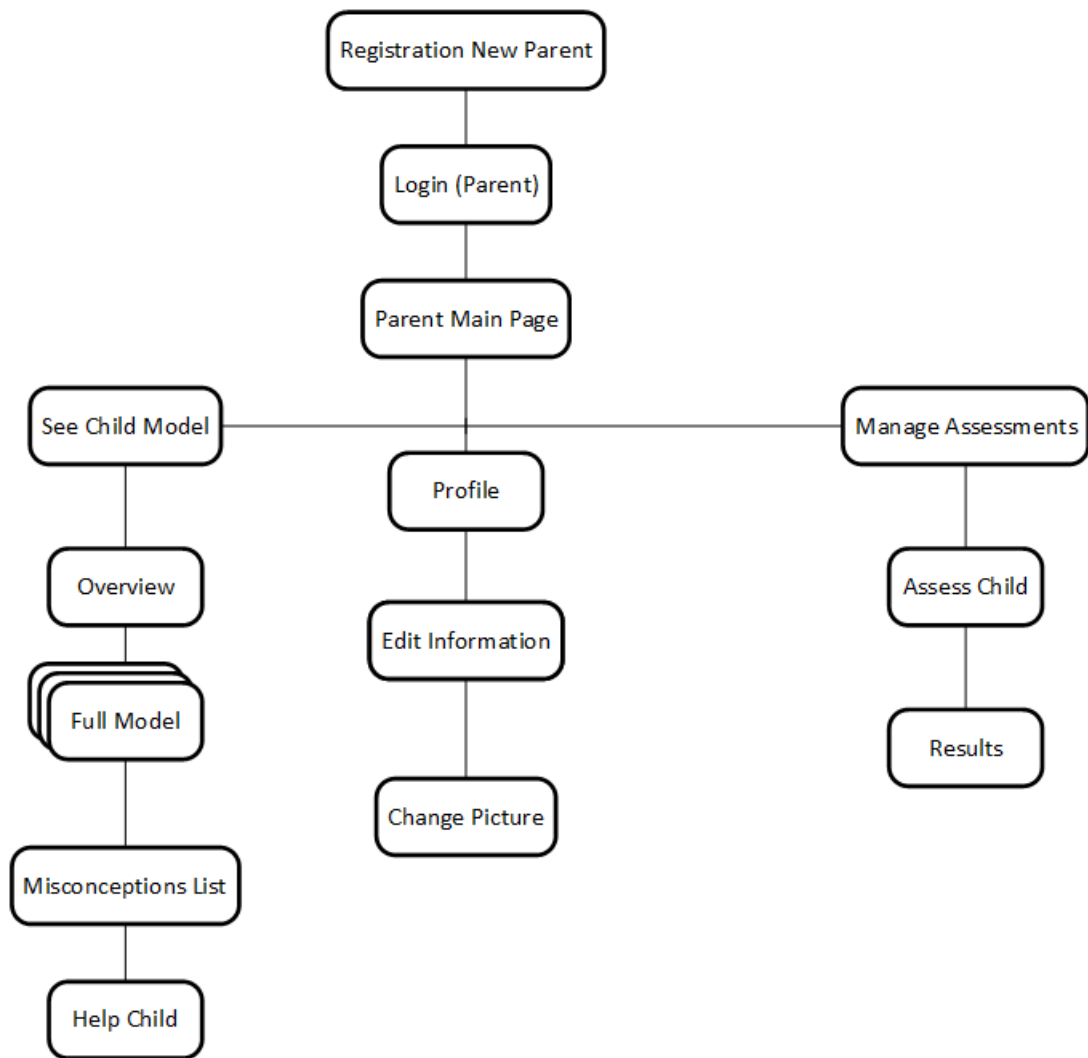
FIGURE 4.14: Parent's Environment.

The main pages in this environment are:

1. **Parent's Profile Page**, this page presents the basic information about the parents such as the name, email and so on. The system allows the parents to edit their information.

2. **Parents Assessing their Children Page**,the system allows the parents to assess their children. The assessment's values are entered by slider or text field. This assessment's values will be presented in the student model later on.

3. **Parent Viewing their children Models Page**, the system allows the parents to view the student model and find out how their children do.

4.3   Testing the System

The wide usage of the Internet gives us web application strategies and investment value, so that testing of the web application becomes a critical issue, and the testing of web application is the key of success. This section presents the suitable strategies, levels, and methodologies used in testing our system.

4.3.1   Scope of Testing

The test plan (to test our system scope) includes the following:

1. Testing all functional requirements.

2. Testing all nonfunctional requirements.

3. End to end testing of UI of the system.

4.3.2   Test Methodology

- Performance Testing

  To test the performance of our system we are going to use two tools. The first tool was developed by Microsoft, and it is embedded in the Visual Studio itself. The second tool is called WebPagetest, and it is an online and free tool.

- Compatibility Testing

  To test the compatibility, we are going to use two ways. The first way is by using WebPagetest tool. The second way is manually..

4.3.3 Testing Results

1. **Performance Testing Result** This results by using the WebPagetest tool as shown in figures 4.15, 4.16.

	Load Time	First Byte	Start Render	Speed Index	DOM Elements	Document Complete			Fully Loaded			
						Time	Requests	Bytes In	Time	Requests	Bytes In	Cost
First View	1.196s	0.217s	0.790s	1072	80	1.196s	13	345 KB	1.298s	14	350 KB	$----
Repeat View	0.664s	0.131s	0.495s	700	80	0.664s	2	3 KB	0.748s	3	8 KB	

FIGURE 4.15: WebPagetest result
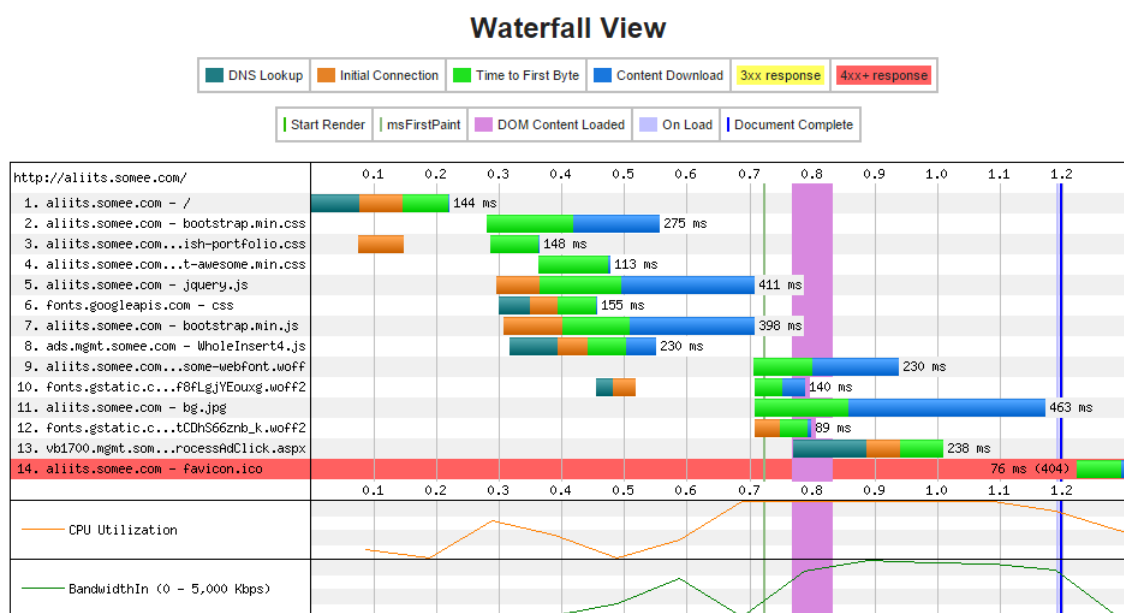
FIGURE 4.16: WebPagetest result2

2. **Portability Testing Result** This results done manually by browsing the system using a mobile device figures 4.17 and 4.18, present some snapshots .

FIGURE 4.17: Mobile snapshot 1
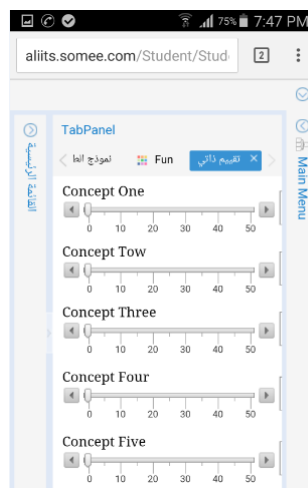
FIGURE 4.18: Mobile snapshot 2

Chapter 5

System Evaluation

This chapter presents an evaluation of the system from different points of view. (1) Evaluate the system against requirements. (2) Evaluate the system with comparison with some existing systems, and finally (3) evaluate the system from the users' point of view.

5.1 Evaluation of the System Against System Requirements

All objectives announced at the beginning of this thesis have been achieved. The system was set up according to the functional and non-functional requirements. Students can now easily register in the system and take the system exam. In addition to assessing themselves, students can negotiate with the system about the level of knowledge. Also, any student can help others peers. The student himself can easily see the student model or he can allow his peers to have a look as well. The teacher can now register in the system, assess the students and see the student model as well as helping them. Furthermore, the teacher can manage the content of the knowledge by adding questions and answers. The parent can also register in the system and assess their children, view the student model and to provide assistance as well.

5.2 Initial Evaluation of the System by Users

In this section, the results of the evaluation from the users' point of view will be shown. In our system, there are four main types of users: students, parents, instructors and supervisors. Therefore, we will give an evaluation result from all types of users.

5.2.1 Evaluation Strategy

We chose a group of 30 students, and gave them an exam from their instructor. After that, the students were divided into three groups; each group had 10 students. The instructor repeated the 5 concepts for the first group in the classroom. In the second group, the students applied the normal ITS (with system evaluation only). In the third group, the students tried our system with (multi entries). At the end, all students were given another exam from the instructor. The different results of our evaluation were due to the differences in the level of enhancement of the students in each group. See table 5.1 to show all the groups' results.

5.2.2 Results Anaylsis

The results of all groups in table 5.1 show us Group1 (in which the students do not use the ITS). In this group, 60% of students improved, 10% fixed and 20% of them declined, as shown in the figures of tables 5.1 and 5.4. Whereas, Group2 in which the students use the classic ITS (with system exam only). In this group, 80% of the students improved, 20% fixed and no one declined, as shown in the figures of tables 5.2 and 5.4. Finally, Group 3 in which the students use our system (with multi entries). In this group, 90% of the students improved, 10% fixed and no one declined, as shown in the figures of tables 5.3 and 5.4.

Student#	Pre exam	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Post exam
G1St1	7						8
G1St2	8						8
G1St3	9						8
G1St4	10						10
G1St5	5						4
G1St6	9						10
G1St7	8						10
G1St8	7						9
G1St9	6						6
G1St10	5						6
G2St1	10	50	45	45	40	50	10
G2St2	9	50	50	40	35	50	10
G2St3	5	35	25	20	15	15	6
G2St4	7	40	30	40	30	25	8
G2St5	4	20	15	10	10	25	5
G2St6	8	35	30	20	25	40	9
G2St7	10	50	50	45	50	50	10
G2St8	9	50	45	30	50	50	10
G2St9	8	45	40	35	35	30	9
G2St10	7	50	40	20	40	15	8
G3St1	9	50	45	45	50	50	10
G3St2	8	45	45	40	35	40	10
G3St3	9	45	45	50	40	40	10
G3St4	9	50	50	45	45	45	10
G3St5	7	40	45	35	25	40	8
G3St6	5	25	20	15	10	20	7
G3St7	5	35	15	10	25	20	6
G3St8	6	35	30	25	25	30	7
G3St9	10	50	50	50	50	50	10
G3St10	4	25	15	20	10	10	6

TABLE 5.1: All groups results
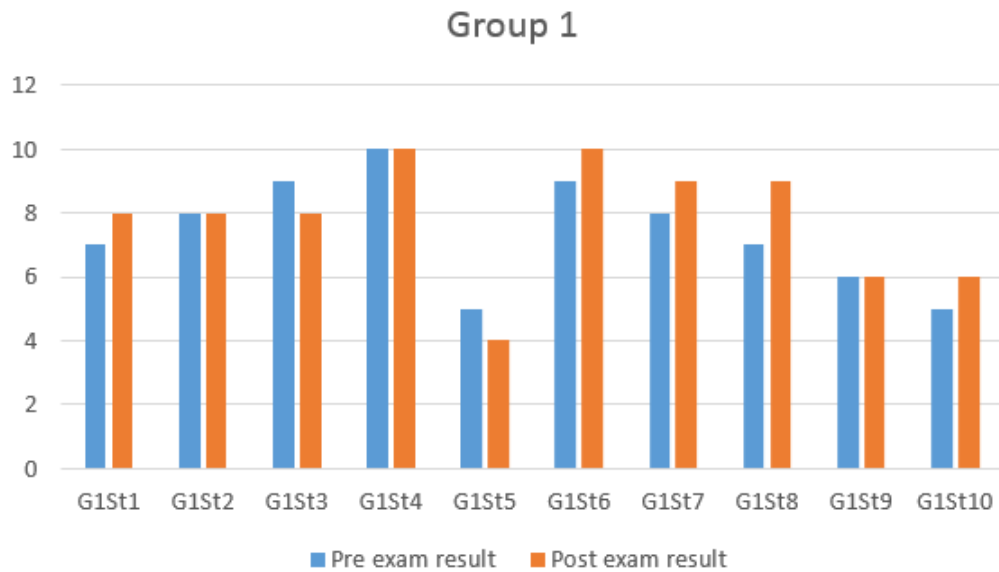
FIGURE 5.1: Group1
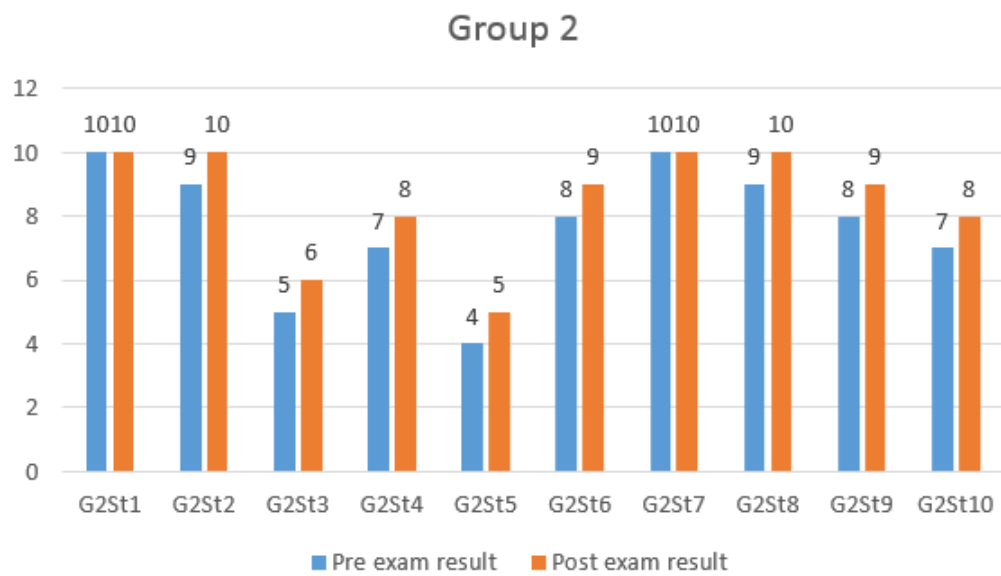
FIGURE 5.2: Group2

FIGURE 5.3: Group3

COMPARISON OF ALL GROUPS

■ Improved ■ Fixed ■ Worse
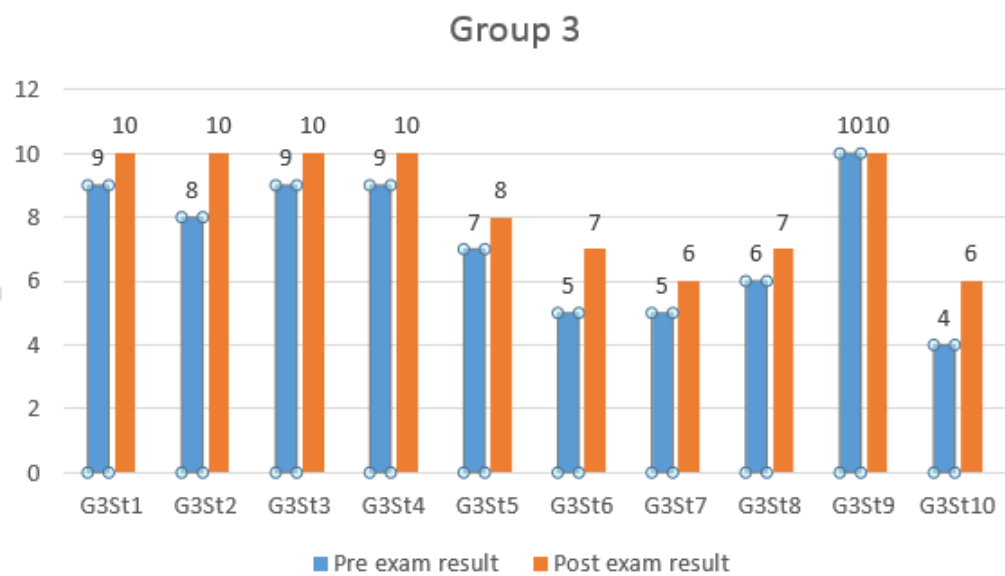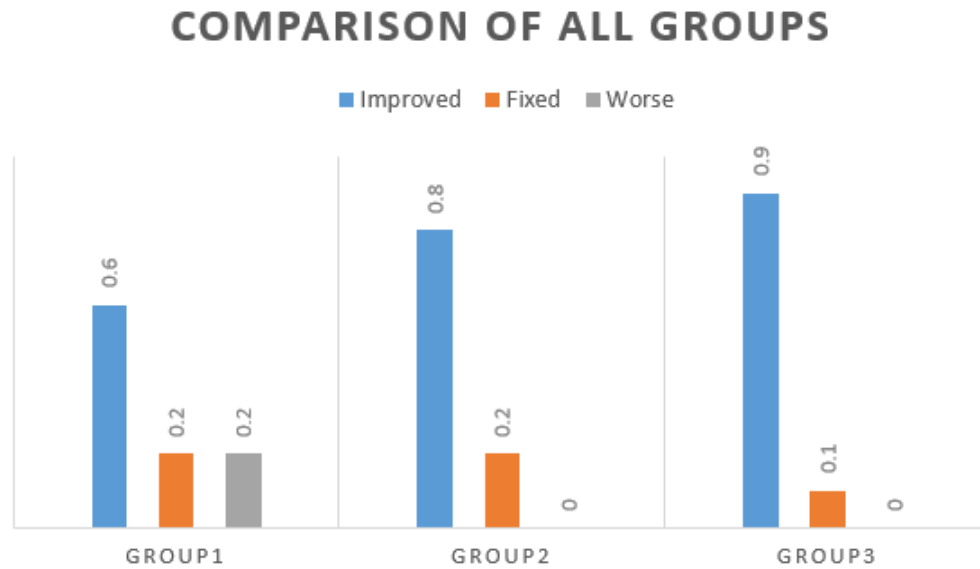
FIGURE 5.4: Comparison all groups

5.2.3 Users Evaluation

A questionnaire was prepared to evaluate the system by users after using it, each user was asked to fill a questionnaire in which all users can express their opinion about the system. Using the results of the questionnaire, it is possible to evaluate the system and to add some modifications suggested by the users. These questions include:

Students' questionnaire questions

1. The software was useful.

2. The software was interesting.

3. The software was easy to use.

4. Giving the student the option to explicitly choose a list of peers and instructors who can see his/her model was useful.

5. All individual models should contribute to the group model.

6. The information inside my model (feedback) was useful.

7. The system helped me to learn.

The figure 5.5 presents result of the analysis of the students' questionnaire
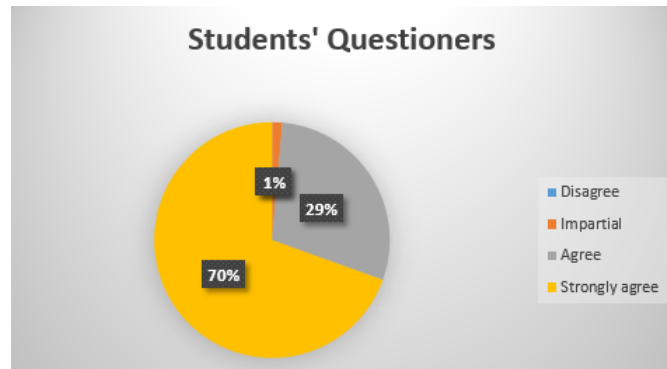
FIGURE 5.5: Student's Questionnaire

Parents' questionnaire questions:

1. The software was useful.

2. The software was interesting.

3. The software was easy to use.

4. Giving the parents to browse their child's model was useful.

5. The information inside child model (feedback) was useful.

6. The system helped me to help child.

The figure 5.6 presents result of the analysis of the Parents' questionnaire

Instructors' questionnaire questions

1. The software was useful.

2. The software was interesting.

3. The software was easy to use.

4. Giving me to browse their students' model was useful.
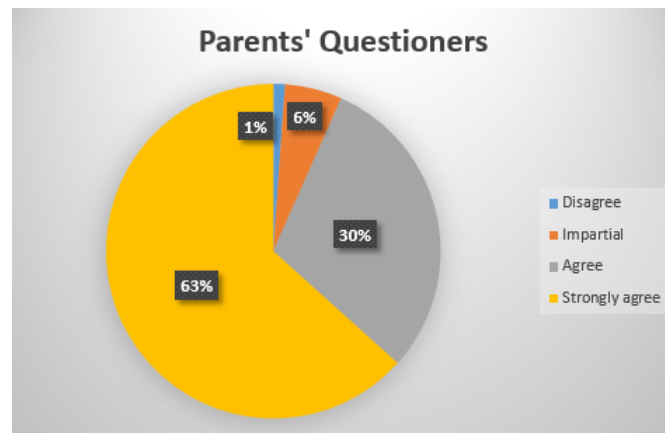
FIGURE 5.6: Parents' Questionnaire

5. The information inside student model (feedback) was useful.

The figure 5.7 presents result of the analysis of the instructors' questionnaire
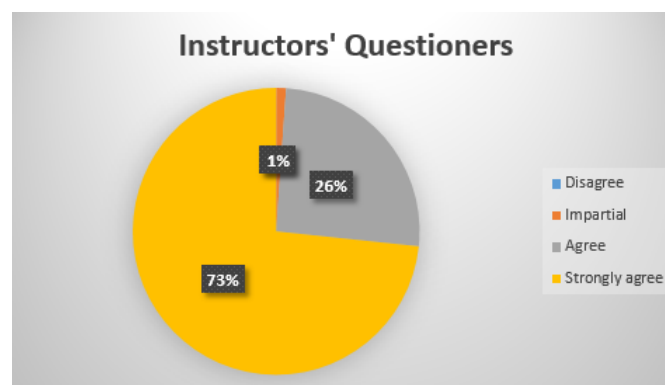
FIGURE 5.7: Instructor's Questionnaire

Statistics from the Web Application

1. 100% of students viewed their models.

2. 100% of parents viewed their children's models.

3. 30% of students opened their models for their peers.

4. 65% of students were in groups.

5. 35% of students had misconceptions.

    6. 10% of students provided assistance to their peers

5.3 Final Evaluation of the System by Users

After we had accomplished the first analysis of the module and compared it with the two previous systems through a 30-student sample, there was an improvement in the level of students in favor of the module. However, this improvement was not substantially obvious or tangible due to the small sample. In this analysis, we used a 60-student sample divided into two groups: a group with a traditional learning system and a group with our model. Then, we followed these steps:

1. Choosing the 60-student sample A sample was randomly chosen according to the school official records for 185 students. 185/30, the answer was 6. We chose students 1, 6, 12 and so on as shown in figure 5.8. Then, we removed the selected names to choose the second ones in the same way. Finally, we had two groups with 30 students in each one.

2. A Pre-test We prepared a pre-test for the 60 students at the same level, and the results were gathered as shown in figure 5.9 for the first group, and in figure 5.10 for second group.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	3	10.0	10.0	10.0
	5.00	2	6.7	6.7	16.7
	6.00	3	10.0	10.0	26.7
	7.00	7	23.3	23.3	50.0
	8.00	10	33.3	33.3	83.3
	9.00	4	13.3	13.3	96.7
	10.00	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

FIGURE 5.9: Traditional Learning Group Pre-test Results

FIGURE 5.8: Students list

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	2	6.7	6.7	6.7
	5.00	4	13.3	13.3	20.0
	6.00	4	13.3	13.3	33.3
	7.00	7	23.3	23.3	56.7
	8.00	7	23.3	23.3	80.0
	9.00	5	16.7	16.7	96.7
	10.00	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

FIGURE 5.10: New Model Group Pre-test Results

3. A Post-test The students in the first group received an explanation to the concepts using the traditional way, then they had the post-test, and the

results were recorded as shown in figure 5.11. Similarly, the students in the second group used the new system, then they had the post-test, and the results were also recorded as shown in figure 5.12.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	3.3	3.3	3.3
	4.00	1	3.3	3.3	6.7
	5.00	1	3.3	3.3	10.0
	6.00	2	6.7	6.7	16.7
	7.00	4	13.3	13.3	30.0
	8.00	7	23.3	23.3	53.3
	9.00	11	36.7	36.7	90.0
	10.00	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

FIGURE 5.11: Traditional Learning Group Post-test Results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6.00	2	6.7	6.7	6.7
	7.00	1	3.3	3.3	10.0
	8.00	5	16.7	16.7	26.7
	9.00	10	33.3	33.3	60.0
	10.00	12	40.0	40.0	100.0
	Total	30	100.0	100.0	

FIGURE 5.12: New Model Group Post-test Results

4. The Hypotheses

1. No statistically significant differences between the two groups in the pre-test.

2. No statistically significant differences in the first group between the pre-test and the post-test.

3. No statistically significant differences in the second group between the pre-test and the post-test.

4. No statistically significant differences between the two groups in the post-test.

5. The Paired T-Test for groups:

1. The T test was applied to prove the first hypothesis, and the results were as shown in figure 5.13. It means that both groups were converged without any significant differences. Thus, the hypothesis is correct.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre_traditional	7.1667	30	1.57750	.28801
	pre_its	7.0667	30	1.59597	.29138

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pre_traditional & pre_its	30	.283	.130

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	pre_traditional - pre_its	.10000	1.90009	.34691	-.6-	.81	.29	29	.775

FIGURE 5.13: Compared the Two Groups of Pre Test Results

2. The T test was applied to prove the second hypothesis, and the results were as shown in figure 5.14. It means that the hypothesis was incorrect, and there is an improvement in favor of the post-test .

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre_traditional	7.1667	30	1.57750	.28801
	post_tradional	7.8667	30	1.81437	.33126

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pre_traditional & post_tradional	30	.888	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pre_traditional - post_tradional	-.70000-	.83666	.15275	-1.01241-	-.38759-	-4.583-	29	.000

FIGURE 5.14: Compared the traditional group of Pre and post Test Results

3. The testing of the third hypothesis is in the following figure 5.15. We found that the hypothesis was incorrect since there was a slight improvement in favor of the post-test, which means that the new module has improved the level of the students.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre_its	7.0667	30	1.59597	.29138
	pos_its	8.9667	30	1.15917	.21163

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pre_its & pos_its	30	.803	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pre_its - pos_its	-1.900-	.95953	.17518	-2.25829-	-1.54171-	-10.846-	29	.000

FIGURE 5.15: Compared our model group of Pre and post Test Results

4. The results of the fourth hypothesis were as the following figure 5.16. It was found that the hypothesis was incorrect, and the post-test of the new module was better than the post-test in the traditional learning.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	post_tradional	7.8667	30	1.81437	.33126
	pos_its	8.9667	30	1.15917	.21163

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	post_tradional & pos_its	30	.195	.303

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	
Pair 1	post_tradional - pos_its	-1.1000-	1.95378	.35671	-1.82955-	-.37045-	-3.08-	29	.004

FIGURE 5.16: Compared the traditional and our model in post Test Results

5.4 Discussion

The increase in the sample size has clearly affected the final results, and it proved that the module had a clear positive influence on improving the students. The module showed that it was more superior comparing with traditional learning systems. The first null hypothesis was to prove that both random groups had no significant differences, and they were equal. This showed some credibility in the results. The second hypothesis was to examine the students' progress if there was any through applying the traditional learning system and observing the students' level. The results showed that the students were improved after applying the traditional learning system, but it was a slight increase. In addition, the system was not able to determine the students' problems or their misconceptions, and it did not consider the individual differences between students. This has had a negative impact that caused the lack of progress between students. The third hypothesis

was to test the students' progress between the pre-test and the post-test after applying the new module. The results have shown a clear improvement with the students after applying the module. Furthermore, the new module dealt with each student separately and it determined his/her misconceptions. The module has also included the students' parents and instructors in the learning process, and that has greatly improved the students' level. The fourth hypothesis was to test the level of superiority between the new module and the traditional learning system. The results have demonstrated a significant superiority and a clear improvement with the students who used the module comparing with the other group. Moreover, they were more motivated, more interactive, more confident and better in accepting their results.

5.4.1 The Mechanism of Evaluating and Testing

The pre-test and post-test are regular paper tests for both groups. However, the difference is in re-explaining the material for the students in the first group: the five concepts were re-explained in a 40-minute class for all students in a real classroom. Regarding the second group, the students were only taught the misconceptions which were recorded for them. Here, I'd like to provide an example:Student 12 was weak in the pre-test concerning the concept of call forwarding to switchboards, which I mentioned previously as an example. The student's final evaluation was 10/50. Therefore, this concept was repeated to him in less than 5 minutes, and he got full mark for this concept in the post-test was. We notice the difference in time and effort for the teacher to make the idea clear to students in short time with a huge difference in the results. We conclude here that the advantage of the system is not only the difference in results but also the time and effort given to restore the student's information effectively.

5.4.2 Some Notes

1. We had a major problem in applying the system with parents because it was not easy to communicate with them and convince them to be honest in what concerned the educational level of their children and their needs. The parents tended to overestimate that the educational level of their children was good. Therefore, we held meetings with them, and we explained that knowing the real level of their children would help to improve them in future.

2. There was an excellent acceptance between young teachers to the idea and they were enthusiastic to apply it on the contrary with the old and traditional teachers who did not know how to use a computer. However, the rate of young and open-minded teachers is increasing and they would like to change the traditional learning pattern.

5.4.3 Recommendations

I can say that the concluded results led us clearly to create an integrated portal with this idea and try to apply it in reality and to adopt this idea in order to raise the educational level in general. In addition, we can try to accomplish the main objectives such as involving the parents in the educational process as well as the student himself/herself, and that will have a positive impact on their academic achievements later.

5.5 Evaluation of the System with Reference to Similar Systems

In this section, we'll show a comparison between the student model in our system and in other systems:

1. German Tutor : It is an intelligent language tutoring system to learn German grammar [37], the main features in this system are as the following: it is a

full intelligent tutoring system, it supports open learner model, and there are three levels to learn German grammar (Beginners, Intermediate, and Advanced). In the other hand, the system does not allow the instructors or peers to see the student model, and it does not support the groups, also the student model presents the level of the student textually only as shown in see figure 5.17. .

FIGURE 5.17: Student Model- German Tutor[37].

2. SQL-Tutor: It is an intelligent educational system to learn structured query language (SQL) [38]. The main features in this system are as the following: it's a complete intelligent tutoring system, it is specially developed for university-level students only, it supports the open learner model, and the student model presents a textual and graphical information, see figure 5.18. In the other hand, the system does not allow the instructors or peers to see the student model, and it does not support the groups.
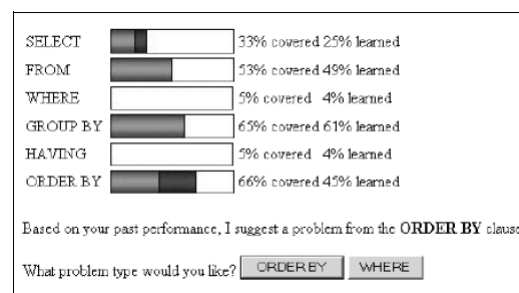
FIGURE 5.18: Student Model- German Tutor[38].

3. Duolingo: It is an intelligent language tutoring system to learn 8 different languages [39]. The main features in this system are as the following: it

#	System	Open	Group	Peers and Instructor	entries	Complete	Content	Student Model	Negotiable	Collaborative
1	German tutor	Yes	No	No	Pre test	Yes	German Grammar Language	textual	No	No
2	SQL-Tutor	Yes	No	No	Pre test	Yes	SQL	Textual & Graphical	No	No
3	Duolingo	No	Yes	No	Pre test	Yes	8 Languages	No	No	Yes
4	Our system	Yes	Yes	Yes	4 Different Entries	No	Any thing	Textual & Graphical	Yes	Yes

TABLE 5.2: The main differences between our system and the three systems

provides free services, it is a completely intelligent system, it provides web and mobile applications, it supports the open learner model, it provides the student groups, and the misconceptions are directly presented to the student when they are located. In the other hand, the system does not allow the instructors or pees to see the full student model as shown in figure 5.19.

FIGURE 5.19: Duolingo Tutor[40].

Table 5.2 shows a summary of the main differences between our system and the three systems.

5.5.1 Threats to Validity

The students' sample of the experiment was relatively small (30 students). Until the results are accurately certified, it should be carried out with larger number of students. Moreover, the experiment is con fined to the category of students whose parents want them to participate in the system, and it's con fined to a limited age category (10th grade). Finally, it is con fined to a relatively few concepts (only five).

Chapter 6

Conclusion and Future Work

This chapter presents in section 6.1 the main conclusions about the thesis. Then section 6.2 shows suggestion for future work .

6.1   Conclusion

The accuracy of the student model is the criterion of the adequacy of the whole intelligent tutoring system ITS. Therefore, we make sure to achieve the best possible accuracy with the student model through entering new resources to the model. These resources are based on allowing the student to evaluate himself in addition to the evaluation of his teacher, parents and the system. This will contribute in achieving bigger accuracy, it will also give the student more desire towards learning because he becomes involved in it as well as his parents who will pay more attention to their child and will enhance him to learn better. The system, which was done to improve the student model, relied on the Open Student Model which depends on revealing what the system thinks about the student to the student himself, or anyone who is chosen by the student from his peers and friends. The student is also allowed to negotiate the system about his knowledge level, and he can try to change what the system thinks about his level through other tests that the student can perform to prove his success. Finally, we evaluated the system

through tow experiments. The first one used (30 students) and with their parents and instructors. The results have shown that our system can improve a student level and enhance his / her motivation for learning, but this experience did not achieve statistical results are clear. The second experiment used (60) students. In this experiment We get a better results because of the larger sample, and we can prove statistically significant improvement among students for the benefit of the new model .In addition, we are able to integrate the parents in the educational process and make them more informed about the educational level of their children. In the other hand, the instructor feels that his / her experience has invested appropriately; moreover, he / she is not neglected as he / she is an indispensable part in the educational process.

6.2 Future Work

In the future, there are many things to work on regarding this system:

1. Create a system, which reads and analyzes the student model, provides scientific and educational proposals for the student, and offers these suggestions for the student himself ,teacher and parents.

2. Add the psychological aspect of the student, which requires action by sensors. They can be connected to the student to analyze the psychology of behavior during the using of the system.

3. Include the students activities and their interaction with the data mining algorithm which will decide later on the extent of the forces of student interaction with the system and the extent of improvement in the educational level of the student.

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Appendix A

Questionnaires

A.1   Message Directorate of Education for schools

بسم الله الرحمن الرحيم

State Of Palestine
Ministry of Education and Higher Education
Directorate of Education - Qalqilia

دولة فلسطين
وزارة التربية والتعليم العالي
مديرية التربية والتعليم – قلقيلية

الرقم :م ت ت / 3 / ٧ / 3755

التاريخ: ١٨ /١٢/ ٢٠١٤م

حضرات مديري ومديرات المدارس المحترمين

تحية طيبة وبعد،،،

الموضوع: تسهيل مهمة

يقوم الطالب علي احمد عبد الرحيم الجدع من جامعة بير زيت بإجراء دراسة ميدانية لتطوير التعلــيم الإلكتروني الذكي للطلبة والمعلمين لتقديمها كمشروع لدراسة الماجستير.

أرجو تسهيل مهمته بما لا يعيق العملية التعليمية.

مع الاحترام

يوسف عودة
مدير التربية والتعليم

- نسخة / التعليم العام
م.ع / خ.ه.ج /

al-QUDS

FIGURE A.1: Message Directorate of Education for schools.

A.2 Students Questionnaire

جامعة بيرزيت – كلية الهندسة وتكنولوجيا المعلومات
برنامج الماجستير في الحوسبة

BIRZEIT UNIVERSITY

استبانة حول تقييم الطالب
(خاص بالطلاب)

الصف _____

يعتبر التقييم للطالب أهم اجراء لأي نظام تعليمي سواء أكان في المراكز التعليمية في الواقع كالمدارس والجامعات أو حتى في النظم الافتراضية للتعليم من خلال شبكة الانترنت او غيرها . والتقييم مهم لأنه يعطي مؤشرا لمستوى معرفة الطالب/ة في موضوع معين ، وبالتالي إمكانية تحديد الاستراتيجيات التربوية المناسبة له /لها. بيد أن الاعتماد الكبير في الحصول على تقييم دقيق للطالب هو الامتحان. لكن نحن نريد ان نبحث في مدخلات أخرى للتقيم كتقييم الطالب لنفسه ، وتقييم المعلم له ، وتقييم أولياء الامور كذلك . هذه الاستبانة سرية، فنرجو عدم كتابة اسمك عليها أو الكشف عن هويتك. وستجمع استجابتك مع استجابات الآخرين من خلال عملية لا تسمح بالتعرف على أي شخص، وستستخدم خلاصة الآراء لتطوير نظام تعليمي ذكي يعتمد على أكثر من مدخل في تقييم الطالب للوصول إلى تقييم أكثر دقة للطالب.

نرجو التفضل بالإجابة عن الأسئلة التالية بوضع اشارة X في المكان الصحيح.

إعداد المعلم : علي أحمد عبد الرحيم الجدع   مشرف رسالة الماجستير : د. عبد اللطيف ابو عيسى

لا أوافق بشدة	لا أوافق	صحيح لحد ما	أوافق	أوافق بشدة		
					■ (أوافق بشدة) تعني أن العبارة صحيحة دائماً أو في كل الأحيان تقريباً، أو أن المطلوب تمت تأديته على أكمل وجه. ■ (أوافق) تعني أن العبارة غالباً أو في أغلب الحيان، أو أن المطلوب تمت تأديته بشكل جيد تقريباً. ■ (صحيح لحد ما) تعني أن المطلوب تمت تأديته بشكل متوسط ■ (لا أوافق) تعني أن المطلوب تمت تأديته بشكل ضعيف أو لم يؤد في معظم الأحيان ■ (لا أوافق بشدة) تعني أن المطلوب تمت تأديته بشكل سيء جدا، أو لم يؤد أصلاً، أو نادراً ما تمت تأديته.		
					أسئلة خاصة بالامتحانات	
					أعتقد أن الامتحانات كافية لتحديد احتياجاتي .	1
					إن توفرت مدخلات اخرى اضافة للامتحانات سيكون افضل.	2
					الامتحانات هي ادق وسيلة للتفريق بين مستويات الطلبة.	3
					لا اقتنع بتقييم الامتحانات لاحتياجاتي .	4

1

FIGURE A.2: Students Questionnaire Page 1.

						أسئلة خاصة بتقييم الطالب لنفسه	
						بامكاني تحديد احتياجاتي التعليمية نفسي بشكل دقيق.	5
						استطيع مساعدة معلمي / معلمتي في تحديد احتياجاتي .	6
						انا راض عن ادائي في اخر امتحانات تقدمت لها.	7
						تحديد الاحتياجات لنفسي أفضل من تقييم الامتحانات.	8
						استطيع تحديد نقاط ضعفي في موضوع معين.	9
						يساعدني الامتحان في رفع قدرتي على تقييم نفسي .	10
						اسئلة خاصة بتقييم المعلم للطالب	
						يستطيع معلمي / معلمتي تحديد احتياجاتي التعليمية بشكل دقيق.	11
						معلمي / معلمتي يساعدني لمعرفة مستوى معرفتي .	12
						معلمي / معلمتي يرشدوني لتخطي مشكلاتي في الدراسة.	13
						معلمي / معلمتي يراعون الفروق الفردية بيني وبين زملائي/زميلاتي.	14
						معلمي / معلمتي يختارون الطرق التدريسية المناسبة لمستواي.	15
						يستطيعي معلمي / معلمتي نقل مستواي لمعلم/معلمة بشكل صحيح.	16
						اسئلة خاصة بتقييم أولياء الأمور للطالب (ولي الامر : أب ، أم ، أخ ، أخت ...)	
						يستطيع ولي أمري تحديد احتياجاتي التعليمية بشكل دقيق	16
						يساعدني ولي أمري في معرفة مستوا معرفتي.	17
						يرشدني ولي امري لتخطي مشكلاتي في الدراسة .	18
						ولي أمري متعليم ومثقف .	19
						يستطيع ولي امري نقل مستواي لمعلمي / معلمتي .	20
						أسئلة مفتوحة	
						حسب وجهة نظرك ماهي النسبة المئوية في الاعتماد على تحديد احتياجاتي في كل من - الامتحانات : .... % - تقييم ذاتي : .... % - تقييم المعلم : .... % - تقييم ولي الامر: .... % ------------------------- المجموع : 100% المجموع : 100%	25
						ما هي المرحلة الدراسية التي يمكن للطالب / بــة تقييم فيها نفسه ؟ --	26
						هل ترغب بالمشاركة بنظام يعتمد مثل هذه الاساليب في التقييم ؟ -- - --------------------	27

2

FIGURE A.3: Students Questionnaire Page 2.

A.3   Teachers Questionnaire

جامعة بيرزيت – كلية الهندسة وتكنولوجيا المعلومات
برنامج الماجستير في الحوسبة

BIRZEIT UNIVERSITY

استبانة حول تقييم الطالب
(خاص بالمعلمين)

يعتبر التقييم للطالب أهم اجراء لأي نظام تعليمي سواء أكان في المراكز التعليمية في الواقع كالمدارس والجامعات أو حتى في النظم الافتراضية للتعليم من خلال شبكة الانترنت او غيرها . والتقييم مهم لأنه يعطي موشرا لمستوى معرفة الطالب/ـة في موضوع معين ، وبالتالي إمكانية تحديد الاستراتيجيات التربوية المناسبة له /لها. بيد أن الاعتماد الكبير في الحصول على تقييم دقيق للطالب هو الامتحان. لكن نحن نريد ان نبحث في مدخلات أخرى للتقييم كتقييم الطالب لنفسه ، وتقييم المعلم له ، وتقييم أولياء الامور كذلك . هذه الاستبانة سرية، فنرجو عدم كتابة اسمك عليها أو الكشف عن هويتك. وستجمع استجابتك مع استجابات الآخرين من خلال عملية لا تسمح بالتعرف على أي شخص، وستستخدم خلاصة الآراء لتطوير نظام تعليمي ذكي يعتمد على أكثر من مدخل في تقييم الطالب للوصول إلى تقييم أكثر دقة للطالب .

نرجو التفضل بالإجابة عن الأسئلة التالية بوضع اشارة X في المكان الصحيح.

إعداد المعلم : علي أحمد عبد الرحيم الجدع   مشرف رسالة الماجستير : د. عبد اللطيف ابو عيسى

لا أوافق بشدة	لا أوافق	صحيح لحد ما	أوافق	أوافق بشدة		
					▪ (أوافق بشدة) تعني أن العبارة صحيحة دائماً أو في كل الأحيان تقريباً، أو أن المطلوب تمت تأديته على أكمل وجه. ▪ (أوافق) تعني أن العبارة غالباً أو في أغلب الحيان، أو أن المطلوب تمت تأديته بشكل جيد تقريباً. ▪ (صحيح لحد ما) تعني أن المطلوب تمت تأديته بشكل متوسط ▪ (لا أوافق) تعني أن المطلوب تمت تأديته بشكل ضعيف أو لم يؤد في معظم الأحيان ▪ (لا أوافق بشدة) تعني أن المطلوب تمت تأديته بشكل سيء جدا، أو لم يؤد أصلاً، أو نادراً ما تمت تأديته.	
					أسئلة خاصة بالامتحانات	
					أعتقد أن الامتحانات كافية لتحديد احتياجات الطالب التعليمية.	1
					إن توفرت مدخلات أخرى لتحديد الاحتياجات إضافة للامتحانات سيكون أفضل.	2
					الامتحانات هي أدق وسيلة للتمييز بين الطلبة.	3
					لا اقتنع بتقييم الامتحانات لقدرات الطلبة .	4

1

FIGURE A.4: Teachers Questionnaire Page 1.

أسئلة خاصة بتقييم الطالب لنفسه							
						اعتقد أن الطالب يمكنه تحديد احتياجاته بنفسه بشكل ما .	5
						يساعدني الطالب في تحديد احتياجاته .	6
						هناك رضا من الطلبة عن أدائهم في آخر امتحانات تقدموا لها .	7
						تحديد الطالب احتياجاته لنفسه أفضل من تقييم الامتحان له .	8
						يستطيع الطالب تحديد نقاط ضعفه .	9
						يساعد الامتحان الطالب في اكتشاف نقاط ضعفه .	10
اسئلة خاصة بتقييم المعلم للطالب							
						استطيع تحديد احتياجات طلبتي بشكل دقيق .	11
						أساعد طلبتي في تحديد مستواهم .	12
						ارشد طلبتي لتخطي مشكلاتهم الدراسية .	13
						أراعي الفروق الفردية بين طلبتي .	14
						اختار الطرق الدراسية المناسبة لكل فئة من الطلبة .	15
						استطيع نقل مستوى طلبتي لمعلمين آخرين .	16
اسئلة خاصة بتقييم أولياء الأمور للطالب (ولي الامر : أب ، أم ، أخ ، أخت ...)							
						يستطيع ولي أمر الطالب تحديد احتياجات الطالب بشكل دقيق	16
						يساعدني ولي أمرا لطالب في تحديد مستوى معرفته.	17
						يرشد ولي الأمر الطالب لتخطي مشكلاته في الدراسة .	18
						أفضل التعامل مع ولي أمر الطالب المثقف والمتعلم .	19
						يستطيع ولي الأمر نقل مستوى الطالب للمعلم.	20
أسئلة مفتوحة							
					حسب وجهة نظرك ما هي النسبة المئوية في الاعتماد على تحديد احتياجات الطالب في كل من		25

حسب وجهة نظرك ما هي النسبة المئوية في الاعتماد على تحديد احتياجات الطالب في كل من

-     الامتحانات   : .... %
-     تقييم الطالب لنفسه   : .... %
-     تقييم المعلم للطالب   : .... %
-     تقييم ولي الامر للطالب: .... %

المجموع :   100%

ما هي المرحلة الدراسية التي يمكن للطالب / ــة تقييم فيها نفسه ؟		26

هل ترغب بالمشاركة بنظام يعتمد مثل هذه الأساليب في التقييم ؟		27
--- -----		

2

FIGURE A.5: Teachers Questionnaire Page 2.

A.4   Parents Questionnaire

جامعة بيرزيت – كلية الهندسة وتكنولوجيا المعلومات
برنامج الماجستير في الحوسبة

استبانة حول تقييم الطالب

يعتبر التقييم للطالب أهم اجراء لأي نظام تعليمي سواء أكان في المراكز التعليمية في الواقع كالمدارس والجامعات أو حتى في النظم الافتراضية للتعليم من خلال شبكة الانترنت او غيرها . والتقييم مهم لأنه يعطي موشرا لمستوى معرفة الطالب/ة في موضوع معين ، وبالتالي إمكانية تحديد الاستراتيجيات التربوية المناسبة له /لها. بيد أن الاعتماد الكبير في الحصول على تقييم دقيق للطالب هو الامتحان. لكن نحن نريد ان نبحث في مدخلات أخرى للتقيم كتقييم الطالب لنفسه ، وتقييم المعلم له ، وتقييم أولياء الامور كذلك . هذه الاستبانة سرية، فنرجو عدم كتابة اسمك عليها أو الكشف عن هويتك . وستجمع استجابتك مع استجابات الآخرين من خلال عملية لا تسمح بالتعرف على أي شخص، وستستخدم خلاصة الآراء لتطوير نظام تعليمي ذكي يعتمد على أكثر من مدخل في تقييم الطالب للوصول إلى تقييم أكثر دقة للطالب.

نرجو التفضل بالإجابة عن الأسئلة التالية بوضع اشارة X في المكان الصحيح.

إعداد المعلم : علي أحمد عبد الرحيم الجدع   مشرف رسالة الماجستير : د. عبد اللطيف ابو عيسى

لا أوافق بشدة	لا أوافق	صحيح لحد ما	أوافق	أوافق بشدة		
					■ (أوافق بشدة) تعني أن العبارة صحيحة دائماً أو في كل الأحيان تقريباً، أو أن المطلوب تمت تأديته على أكمل وجه. ■ (أوافق) تعني أن العبارة غالباً أو في أغلب الحيان، أو أن المطلوب تمت تأديته بشكل جيد تقريباً. ■ (صحيح لحد ما) تعني أن المطلوب تمت تأديته بشكل متوسط ■ (لا أوافق) تعني أن المطلوب تمت تأديته بشكل ضعيف أو لم يؤد في معظم الأحيان ■ (لا أوافق بشدة) تعني أن المطلوب تمت تأديته بشكل سيء جدا، أو لم يؤد أصلاً، أو نادراً ما تمت تأديته.		
					أسئلة خاصة بالامحتانات	
					أعتقد أن الامتحانات كافية لتحديد احتياجات الطالب .	1
					إن توفرت مدخلات اخرى اضافة للامتحانات سيكون افضل.	2
					الامتحانات هي ادق وسيلة للتمييز بين الطلبة.	3
					لا اقتنع بتقييم الامتحانات لقدرات الطلبة .	4

1

FIGURE A.6: Parents Questionnaire Page 1.

				أسئلة خاصة بتقييم الطالب لنفسه	
				اعتقد أن الطالب يمكنه تحديد احتياجاته التعليمية لنفسه بشكل ما .	5
				يساعدني الطالب في تحديد احتياجاته .	6
				هناك رضى من الطلبة عن ادائهم في اخر امتحانات تقدموا لها .	7
				تحديد الطالب لاحتياجاته لنفسه أفضل من تقييم الامتحان له .	8
				يستطيع الطالب تحديد نقاط ضعفه .	9
				يساعد الامتحان الطالب في اكتشاف نقاط ضعفه .	10
				اسئلة خاصة بتقييم المعلم للطالب	
				يستطيع المعلم تحديد احتياجات طلبته بشكل دقيق .	11
				يساعد المعلم طلبته في تحديد مستواهم .	12
				يرشد المعلم طلبته لتخطي مشكلاتهم الدراسية .	13
				يراعي المعلم الفروق الفردية بين طلبته .	14
				يختار المعلم الطرق الدراسية المناسبة لكل فئة من الطلبة .	15
				يستطيع المعلم نقل مستوى طلبته لأولياء الامور بشكل دقيق .	16
				اسئلة خاصة بتقييم أولياء الأمور للطالب (ولي الامر : أب ، أم ، أخ ، أخت ...)	
				استطيع تحديد احتياجات الطالب بشكل دقيق	16
				اساعد الطالب في تحديد مستوى معرفته.	17
				أرشد الطالب لتخطي مشكلاته في الدراسة .	18
				مستوى ثقافة وعلم ولي الامر مهم لتفوق الطالب	19
				استطيع نقل مستوى الطالب للمعلم.	20
				أسئلة مفتوحة	
				حسب وجهة نظرك ماهي النسبة المئوية في الاعتماد على تحديد احتياجات الطالب في كل من - الامتحانات : .... % - تقييم الطالب لنفسه : .... % - تقييم المعلم للطالب : .... % - تقييم ولي الامر للطالب: .... % ------------------------- المجموع : 100%	25
				ما هي المرحلة الدراسية التي يمكن للطالب / بــة تقييم فيها نفسه ؟ --	26
				هل ترغب بالمشاركة بنظام يعتمد مثل هذه الاساليب في التقييم ؟ --	27

2

FIGURE A.7: Parents Questionnaire Page 2.

Appendix B

Feasibility Study

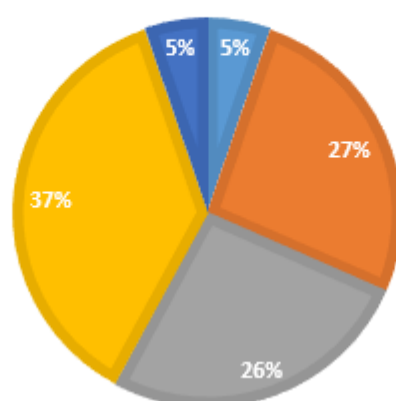# B.1 Students Data

B.1.0.1 Student Data Collection Section A
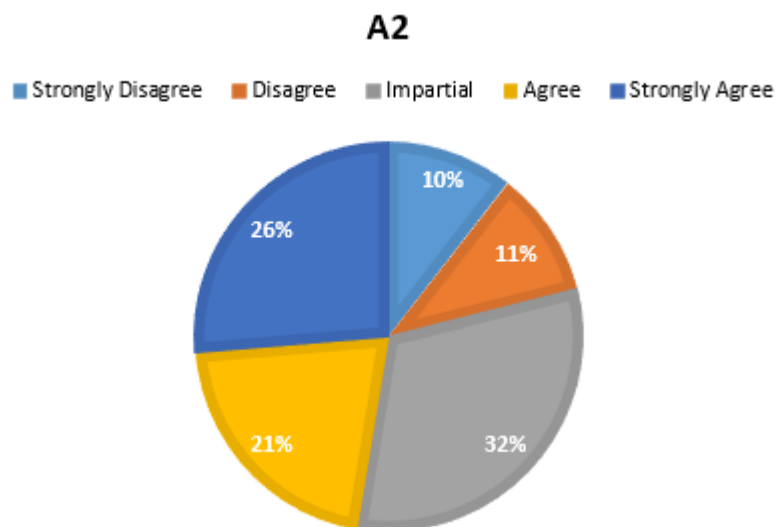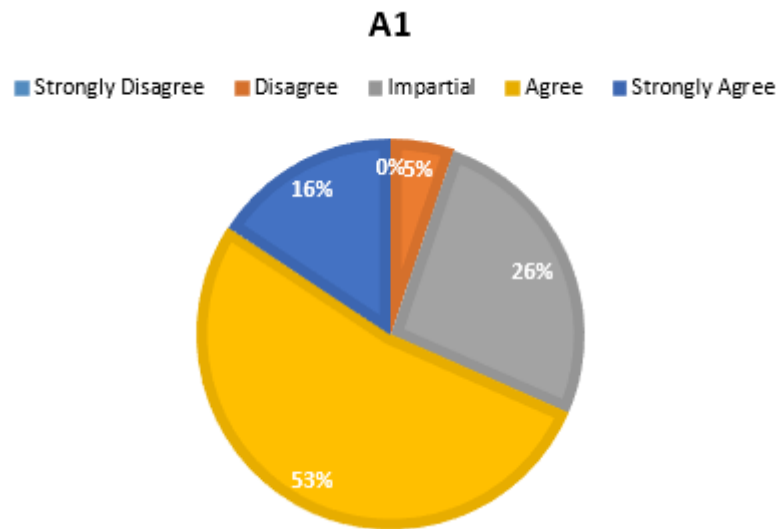
A2

A4
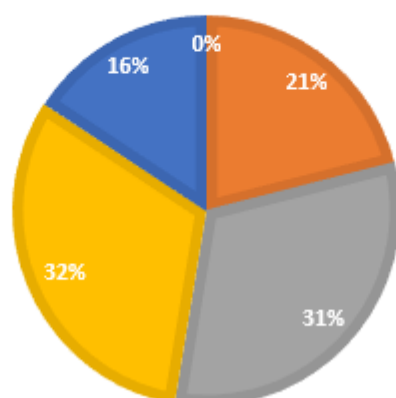
B.1.0.2 Student Data Collection Section B
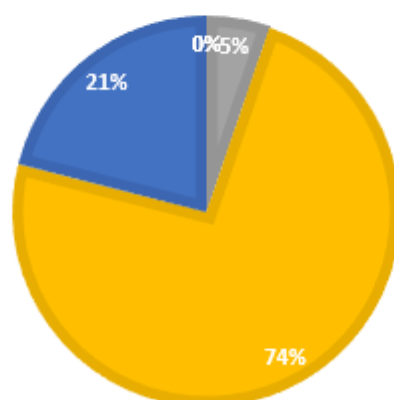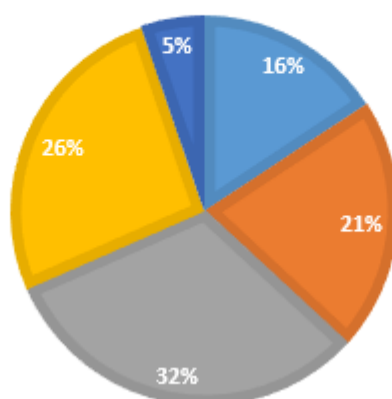
B1

Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree
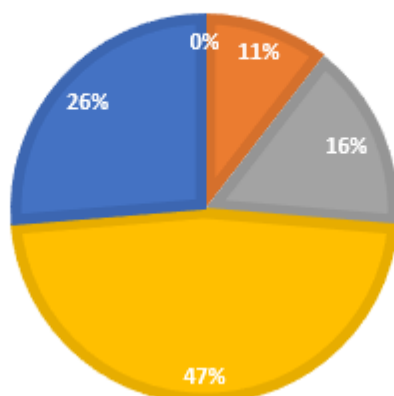
B2
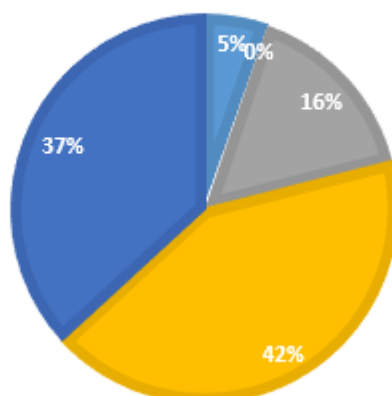
■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

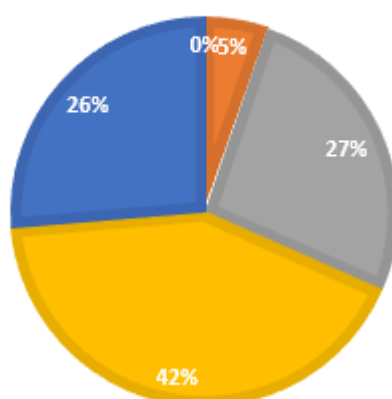
B3

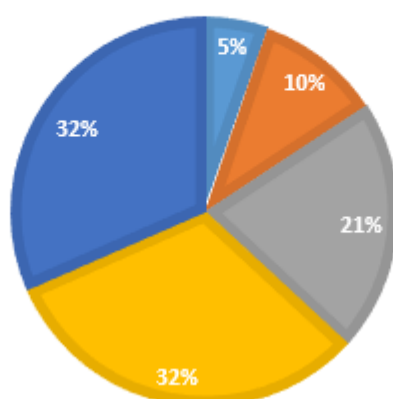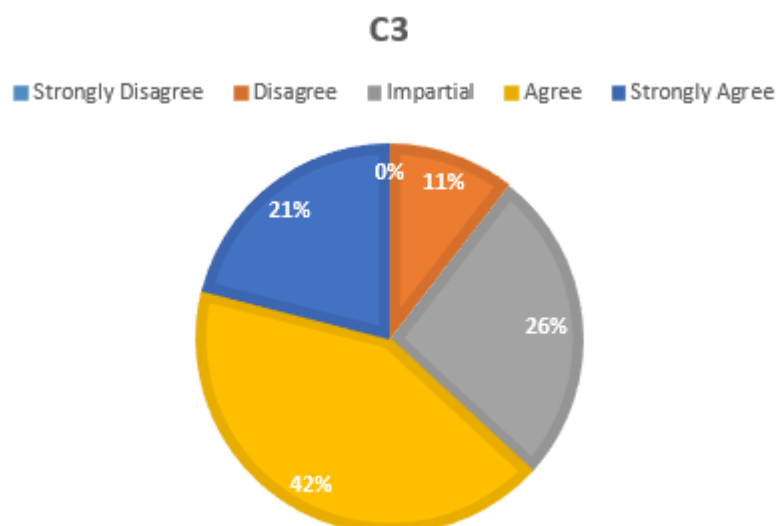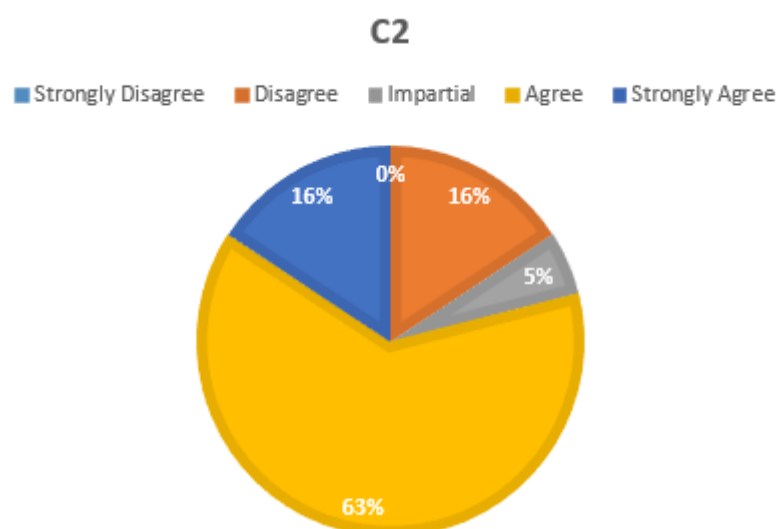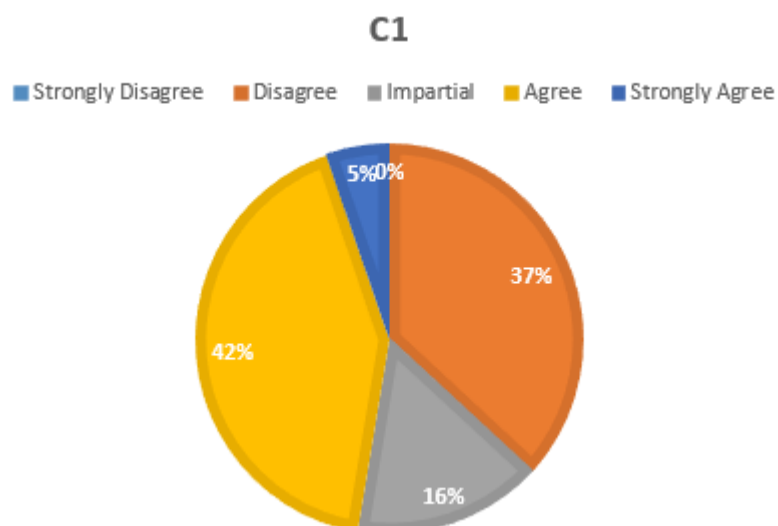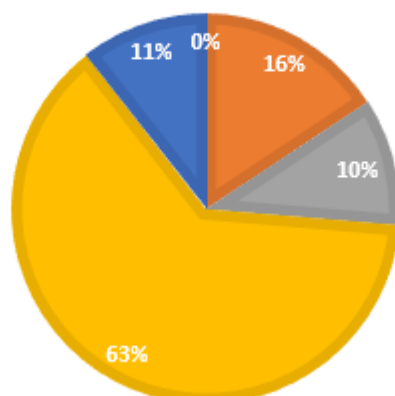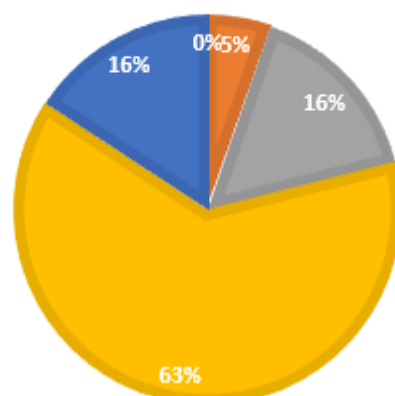■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

B4

Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

B5

Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

B6

Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree
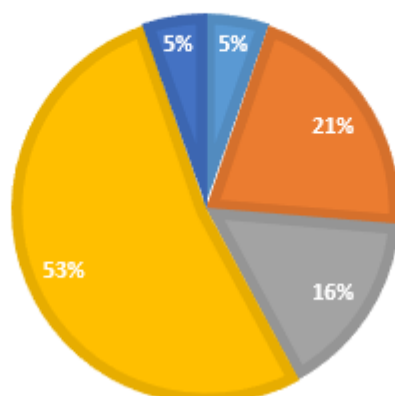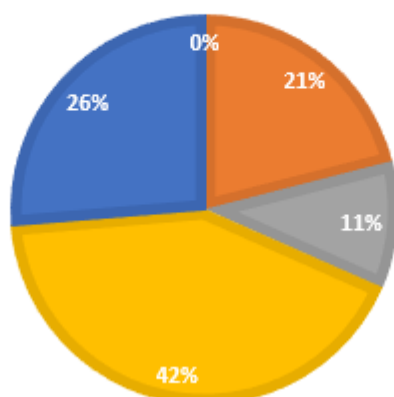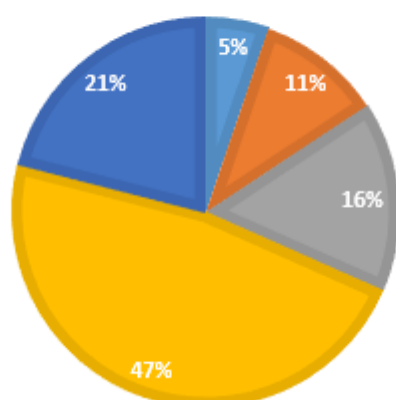
B.1.0.3 Student Data Collection Section C

C1
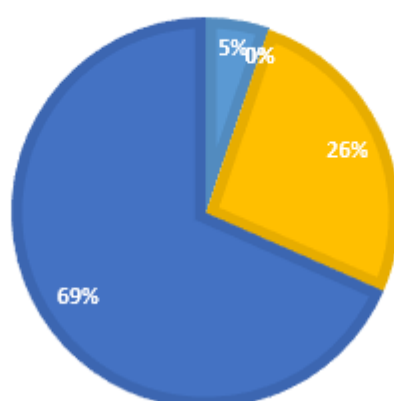
Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

C2

■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

C3

■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

C4

Legend: Strongly Disagree, Disagree, Impartial, Agree, Strongly Agree

C5

Legend: Strongly Disagree, Disagree, Impartial, Agree, Strongly Agree

C6

Legend: Strongly Disagree, Disagree, Impartial, Agree, Strongly Agree

B.1.0.4 Student Data Collection Section D

D1

■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

D2

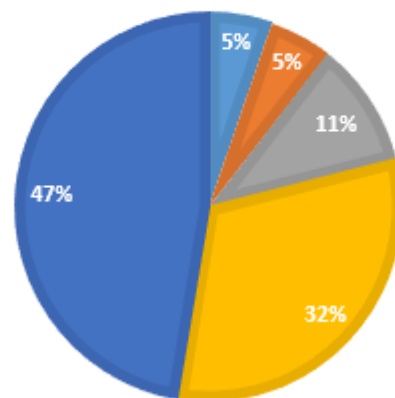■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree

D3

■ Strongly Disagree ■ Disagree ■ Impartial ■ Agree ■ Strongly Agree
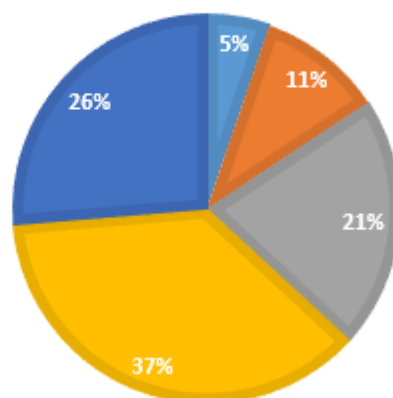
D4

D5

B.1.1 Students Responsive

Group A

Group B

Group C